ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

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CCCXXVII.—ST. VINCENT ARROWROOT.

About three years ago, at the request of the Government of the Windward Islands, a somewhat exhaustive inquiry was undertaken at Kew into the circumstances of the arrowroot industry at St. Vincent. Arrowroot, next to sugar, has been a staple article of export from this interesting island. In fact St. Vincent arrowroot forms one of the principal sources of supply of this well known article of food, and, until about three or four years ago, its production supported a fairly prosperous industry. In 1889 the Honourable Sir Walter Hely-Hutchinson, K.C.M.G., Governor-in-Chief of the Windward Islands, was struck by the depressed condition into which it had fallen, and, with the energy and enterprise which characterised his administration, he sought to trace the causes which had led to the decay of an industry that hitherto had been a source of wealth to the island.

The appeal to Kew was supplemented by so complete a supply of information and material on which to base an inquiry that no hesitation was felt to do what was possible in the matter. Such an inquiry was also in harmony with the aid that Kew had always freely placed at the disposal of such of Her Majesty's Colonies as required it, and especially under circumstances of depression that inevitably follow the temporary or permanent decay of local industries. The result of the investigation undertaken by Kew in the present instance is fully given in the following correspondence. This correspondence, it may be mentioned, was made immediately available at the time through the *Government Gazette* of St. Vincent, and planters were placed in a position to judge exactly how far the depressed condition of their industry was within their own control and what steps should be taken to bring it back to the prosperous position it had once occupied.

There are reasons to believe that the suggestions made to the St. Vincent planters in 1890 have proved of material service to them. Since 1890 the arrowroot industry has certainly revived, and although much of this revival may have been due to purely accidental causes or to favourable changes in the world's markets, there remains however an appreciable margin of probability in favour of better cultivation and of improved methods of manufacture. For this and other reasons it is desirable to place the facts elicited in the course of the inquiry on record in the pages of the *Kew Bulletin*.

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The Administrator, St. Vincent, to Royal Gardens, Kew.

Government House, St. Vincent.
February 16, 1890.

Dear Mr. Morris,

By to-day's mail I am sending addressed to you a box containing :— (1.) Samples of manufactured arrowroot. (2.) Samples of the plant. (3.) Samples of the soil. (4.) Description of the mode of cultivation. (5.) Description of the mode of manufacture.

These have been selected from the three best arrowroot estates in the island, viz., "Fancy," "Owia" and "Wallilabo."

Sir Walter Hely-Hutchinson asked me to forward the above to you by this mail, saying he was writing to you to find out whether anything could be done to place the St. Vincent arrowroot of the better qualities on anything like the same footing as the Bermuda arrowroot.

The description of the mode of cultivation and manufacture at the Wallilabo Estate you will find inside the tin box containing the sample of arrowroot from that estate. I enclose in this the bill of lading for the box.

I remain, &c.

D. Morris, Esq., M.A., F.L.S.
Royal Gardens, Kew.

(Signed) Irwin C. Maling.

Arrowroot Cultivation.

The following particulars respecting the cultivation of arrowroot in St. Vincent have been furnished by the managers of Fancy and Owia estates in that Island :—

Fancy Estate.

Cultivation of Arrowroot.—The land is cleaned of bush and weeds by burning or burying them. Then holes are made with the hoe, about 4 inches deep and 8 inches apart, and a piece of root, two or three joints, put in each hole. As soon as the roots commence to grow and the leaves appear above the surface the land must be carefully weeded with a small hoe. This to be repeated in about five or six weeks; if the weeds grow rapidly it should be done sooner. In good soil three weedings are sufficient. When the leaves get yellow and the stalk falls, which will happen in from 10 to 11 months after being planted, the roots are fit to be dug.

Owia Estate.

Arrowroot Cultivation.—Arrowroot requires some care in the selection of the land intended for planting, loose or sandy soils apparently suiting it best, though there are districts in which the soil is most undoubtedly clayey producing fairly good results in its cultivation.

New land would be cleared by having the trees cut down, the underwood, bush, &c., if heavy and plentiful, heaped and burnt, the heavy trunks being left to rot or made into charcoal, some trunks at Owia are visible which must have been felled 20 odd years ago.

The land is next ploughed, or more correctly speaking, "hoed up," no other implements being used but hoes; the product of the cutting and burning (any charcoal made having been removed for sale first) is buried in, and the "bits" or top joints of the tuber are lightly buried

in, in rows about 6 inches apart. Roots (as the tubers are here called) which have been about a week dug are found to be best for planting.

The time of planting depends very much on the exigencies of the estates; lands in an established estate are planted to "come in" or be ripe for reaping at such time as the already established cultivation would allow of being manufactured without damage to either. Here, of course, comes in a difficulty for the planter; a very dry season will bring all his arrowroot ripe together about January or February, and out of a cultivation yielding 700 barrels he can only manufacture 125 barrels per month, hence a good deal of his crop has to be manufactured either before or after it is properly ripe.

In wet weather, two or three weeks after planting leaves begin to show above ground, three weeks later the plants are sufficiently grown, as are also the weeds, to be weeded, principally by hand by women, whose duty it is to pull up and collect in heaps everything growing which is not arrowroot; certain kinds of weeds have to be loosened with small hoes. Three to four weeks later, by which time it is presumed that all the "bits" which were capable of growing have grown and shown leaves, the business of supplying is performed, that is, spaces where no arrowroot appears are replanted.

About six weeks after being supplied the fields again require weeding, the weeds being left on the surface and the plants lightly moulded up. After this, at intervals as required, the land is weeded, the more quickly the arrowroot grows, and so covers the ground, the smaller the number of weedings being required. After supplying, three weedings are generally sufficient, it being very essential to proper cultivation to keep it free from weeds.

The arrowroot ripens in 10 to 12 months from time of planting, and shows that it is ripe by "falling," that is, the leaves dry and the stalks bend at the root till the whole lies on the ground.

Some fields mature sooner than others, eight months' of growth being in some few places sufficient for maturity, giving, at the same time, a good yield; others, again, take full 12 months.

The arrowroot plant does not require over-much rain, this tending to produce leaves and not root which is what is wanted, and with our seasons the growth appears to continue until the rains stop, the ripening following closely on the cessation of the rains, an early heavy rainfall during, or towards the close of, the dry season materially reducing the yield of arrowroot, on account of the roots "springing" and throwing out young shoots, the roots then containing more water than starch.

The only manure ever used at Owia is farmyard manure, laid on before the land is ploughed or hoed up, and buried in with the ploughing.

The process of reaping is: In fields where there is considerable growth of leaves the stalks are cut down and heaped, and labourers are put in with hoes, who dig out the roots in breadths, each labourer putting the roots dug at one side of his breadth, breaking off the top joints of the roots and burying them in as plants for the succeeding crop. This system of ratooning is allowed to run on, in some cases, 15 and 16 years.

The roots are afterwards measured, collected, and carted to the mill for manufacture. In digging out, everything on the surface is buried in as manure for the next crop.

Arrowroot Manufacture.

The following account of the manufacture of arrowroot in St. Vincent was contributed by the late Mr. J. W. Macdonald to the *Journal of the Society of Chemical Industry* in 1887. Mr. Macdonald was proprietor of Wallilabo Estate, and one of the most successful manufacturers of St. Vincent arrowroot :—

Wallilabo Estate.

(Reprinted from the *Journal of the Society of Chemical Industry*, May 31, 1887.)

Arrowroot (*Maranta arundinacea*) is a native of the tropics. The island of St. Vincent, in the West Indies, has taken the foremost part in its growth and production; a fair quantity is also made in Natal and smaller quantities in India, Fiji, Queensland, and other countries. Formerly, the Bermuda Islands produced a great deal, but, as there is very little arable land and a scarcity of water, and the inhabitants having turned their attention to growing early vegetables for the New York markets, arrowroot is gradually being given up.

Planting.—In St. Vincent the plant grows 2 to 3 feet high. It has a weak fibrous stalk with six to eight arrow-shaped leaves, resembling the leaves of the lily. When the root is ripe, these leaves fall and wither. The plant flowers but does not bear seed, and is therefore propagated by the root. This can be done in two ways, either by pulling the green stalks, trimming off the long hairy roots, and setting them 6 inches apart in fields previously prepared for their reception, or, as is most generally done, by returning to the soil the upper end of the root, which is hard and fibrous and contains very little starch. As the fields are dug up, the labourers pick out the roots and break off these top pieces four to six inches long returning them to the soil. In this way reaping and planting go on simultaneously. Care must be taken, however, to avoid returning to the soil small thin weak roots. The roots commence to grow in about a fortnight, but, to avoid choking the fields, have to be weeded two or three times. In about 10 to 12 months the roots are ripe, and are then 12 to 18 inches below the surface. If they are reaped before being properly ripe, the next crop suffers and frequently takes 15 months to mature, and the fields require to be frequently weeded. With careful attention and manuring, fields will produce crops continually. The arrowroot is a very hardy plant, and will continue to grow up and die down for years after its cultivation has ceased in a field. The roots are long and tap shaped, and are jointed at intervals of $\frac{3}{4}$ to 1 inch. In the soil they are protected by a fibrous covering which grows from each joint, the folds overlapping each other to the end of the root. Full grown roots are from 10 to 18 inches long, the most starch being found in the lower or younger end.

Manufacture.—The first part of the manufacturing process is to soak the roots in water to soften the covering and the adhering earth. They are then stripped of the covering and washed, and thrown into a second or rinsing tank. When thoroughly clean they are taken to the pulping machine. The skin is said to contain a resinous matter, which gives a yellow tinge and unpleasant flavour to the starch if the latter is not well washed. In former times the roots were very carefully skinned with German silver knives before being pulped. This is said to have pro-

duced whiter starch, but as it was so laborious and expensive, it was discontinued. The skinned roots were pulped by subjecting them to great pressure by passing them through an upper, and then a lower and much closer, pair of polished brass rollers, to break the starch cells. The method of pulping now generally adopted is to feed the clean unskinned roots against a fine saw grater very similar to a potato grater. It is a solid cylinder of hard wood about 23 inches diameter and 7 inches wide. Slits are made by a saw from end to end of the wood at $\frac{1}{2}$-inch intervals. Saw blades having six to ten teeth to the inch are then fitted into the slits, and the whole immersed in water to swell the wood and fix the saws. The grater is now fitted into its place very close to a wooden feeding bed. As it revolves several hundred times per minute it tears the roots into shreds. A great deal, however, depends on the fineness of the teeth and the velocity of the drum.

On account of the very fibrous nature of the pulp, there is considerable difficulty in the sieving or separating the starch from it. The fibres readily gather into lumps and enclose the starch, so that hand sieving, although very tedious, has to be resorted to. The pulp is first run into a box or sieve, the bottom of which is a sheet of copper or tin punched with holes about $\frac{1}{6}$-inch diameter. While water flows on, the contents are kept thoroughly agitated by hand, until all the starch has been washed out. While one strainer full is being washed another is being filled, so that there should be no delay. However careful one is, there is a loss of starch in the fibre owing to the presence of small bits of the roots which have escaped pulping.

In one factory, instead of the above strainer a tin-lined copper cylinder has been tried. The cylinder was stationary, its under side being pierced with holes, and inside paddles or beaters revolved at great speed amongst the pulp and water, until the latter flowed away free from starch. The washed fibre was then removed and a fresh charge of pulp put in. This, however, has been discontinued. In another factory, a half cylinder, also stationary, is in course of erection. Its under side is also pierced with small holes, but there is a slide under this to open or close at will. Inside, there are rakes attached to two shafts, which move in opposite directions, and cause the rakes to oscillate very rapidly between each other, thereby keeping the fibre always open. The starch water is let out, more water run in, and the operation repeated until the starch has ceased; then the fibre is taken out. The great objection to any mechanical washer is the tendency of the fibre to accumulate on the agitators and break them. I do not know at present of a single mechanical washer being in use. To get over this difficulty, it has been proposed to chop up or slice the roots into small short pieces, and either rasp them or pass them through metal rollers or mill-stones, so that the thin disintegrated pulp may flow over mechanical sieves. I do not know if this plan has yet been tried. Although causing a loss of starch, the present method of rasping avoids an undue pulverising of the soft yellow fibre, and so gives a very white starch without much further trouble.

From the fibre strainers the starch water flows consecutively through a series of brass wire sieves of 40, 80, and 100 meshes; each of these retain small fleshy bits of unpulped root. From the last sieve the water runs into the settling cisterns, which are preferably lined with white glazed tiles to avoid accumulation of slime.

A portion of the fibre collected on the finer sieves, and also the coarse fibre, is used for feeding the animals on the estate, the remainder and all the coarse fibre are used as manure. For this purpose it is left in heaps until it decomposes, after which it is distributed on the fields along with

pen manure. Sometimes also ashes and guano are used. The waste water from washing the starch contains a considerable amount of vegetable matter, and gives good results where it is run on the fields, but the extensive application of this is not practicable. After the starch has settled in the cisterns, the water is run off and more added, the whole is stirred up (optional) and again allowed to settle. This generally suffices to dissolve out soluble matters. At night all the cisterns are drained, and the starch is dug out and taken to a mixing box, where it is mixed with about twice its volume of water, then run through another fine sieve into the separating pans. These are small round galvanised cisterns with smooth perpendicular sides. When filled, the starch milk is stirred round with a round stick until it is in violent circulation. The stick is withdrawn and the cisterns left until morning. The stirring has the effect of separating the starch from any remaining impurities. These, being of less specific gravity, settle last, and therefore on top of the starch. Next morning the water is drained off, and the light impure starch scraped off the surface. If the earlier parts of the process are carelessly done, this separation may have to be repeated before the starch is quite pure. Even should the separation be perfect, re-washing is beneficial for further removal of vegetable matter. The impure surface starch contains a large proportion of starch entangled in very fine particles of fibre and broken cell walls. Although this can be dried and exported as an inferior starch, it is generally given to the labourers as a perquisite. It is used in various forms as flour. Poultry and pigs are also fed with it. Weak caustic soda extracts a colouring matter from it, but also precipitates a yellow substance, making it very difficult to separate the starch from it in a pure state.

The pure starch in the separators is now taken out in blocks, and placed on trays for about 12 hours to drain and harden. It is then broken into smaller pieces, and taken to the drying house, where it is air dried. This building is open on all sides for free circulation of air. It is surrounded, however, with galvanised wire to keep out the small birds which hover about. Inside there are wire shelves over large shallow wooden trays. The wet lumps of starch are placed side by side on the top shelf, where they remain, until by the action of the air they crack up and fall through on to the next shelf. In time, the whole falls through the lowest shelf, and is in a fine granular state, ready for packing. It contains from 14 to 17 per cent. of water. In cold, wet weather, the starch dries very slowly, taking sometimes as long as two weeks. During this time, if the starch has been imperfectly purified, or placed too close on the wires, the lump gets sour, and becomes yellowish. Indeed, the whole process must be as rapid as possible. In the settling cisterns especially, if the starch is left in contact with the impure water too long, its whiteness is affected, fermentation having taken place. The crop lasts from October to May. The name "arrowroot" is, I think, derived from the Indian word, Ara-ruta, or " mealy root," but some say that this root has been confounded with the *Alpinia Galanga*, which was called the arrowroot on account of its bruised roots being used as an antidote to the poison of the *Jatropha Manihot*, which was used for poisoning their arrows. I may say that tapioca starch is obtained from this poisonous root. The poison, however, is contained in the juice only, and is destroyed by heat.

Yield.— Regarding the yield of arrowroot, an acre will produce 13,000 to 15,000 lb. of roots, according to the season ; in wet seasons the roots are heavy and moist, and give less starch. A fair average yield is 22 cwt. air-dried starch, with 14 per cent. water, per acre, or

about 19 per cent. on good roots. I have no doubt that this will be considerably increased by the use of much-needed improved pulping and sieving machinery.

Chemical Composition.—The roots that I have analysed got slightly dried in transit, so that they show a rather high amount of starch. The analysis, however, will give an idea of the constituents of the roots. In some respects it differs from an analysis by Benzon, stated in Ure's Dictionary, and which I append:—

——	J. W. M.	Benzon.
Starch	27·07	26.00
Fibre	2·82	6·00
Fat	0·26	0·07
Albumin	1·56	1·58
Sugar, gum, &c.	4·10	0·60 (Gum)
Ash	1·23	0·25 ($CaCl_2$)
Water	62·96	65·50
	100·00	100·00

The ash consisted of phosphate of lime and alkaline sulphates, and chlorides.

I have made an attempt to introduce the residual coarse fibre as a raw material for paper manufacture, but consumers say that it is too weak, and lacking in tenacity. For paper making the starch still remaining could be recovered by steeping in boiling water, and used for sizing the finished paper.

Owing to the fall in the value of sugar, the production of arrowroot in the West Indies has been extended rather beyond the demand. The wholesale price has consequently fallen to an almost unremunerative point. This low price, however, will permit it to be used for whatever purposes the commoner kinds of starch are now employed. In some respects it is superior to common starch, and one of my chief objects in writing this paper is to draw the attention of large users of starch to this comparatively new source of very fine starch. Arrowroot swells much more readily and with less heat than maize, rice, or wheat starch, and forms a stiffer jelly. It is, therefore, highly adaptable for sizing and laundry purposes. I think this property is attributable to the larger size of the granules of arrowroot starch, which are among the largest of the starch granules, whereas the granules of wheat, maize, and rice starch are very small, and will contain a greater proportion of starch cellulose and less granulose, the latter being the substance which swells when dissolved in hot water. Another use for which arrowroot starch is very suitable on account of its great purity and freedom from chemicals, is for the preparation of powder for the skin. Many of the powders sold are composed of very questionable ingredients. Arrowroot well crushed and dried on a plate before the fire is both simple and safe.

It is as an article of food, however, that it has hitherto been mostly used, but the exorbitant retail price put on it (from 8*d.* to 2*s.* per lb.) has kept it out of general use. Of course, being starch, it cannot have the flesh-forming power of flour and other nitrogenous meals, but it is the purest, most digestible and palatable of the starches, and is devoid of the unpleasant taste or flavour observed in potato starch and in the

so-called cornflour, and other starches extracted from the cereals by the caustic soda and fermentation processes.

Regarding the annual production of arrowroot, I have not been able to obtain many statistics. Bermuda raises only 500 to 700 kegs, so that very little of what is sold as Bermuda really comes from there. Natal produces 2,000 to 3,000 cases, and St. Vincent about 22,000 barrels, 20,000 of which come to England, and most of the remainder is sent to America. The production of other countries is, I believe, very small.

Value of St. Vincent Arrowroot.

Messrs. Fergusson and Forster to Royal Gardens, Kew.

11 and 12, Great Tower Street, London, E.C.,
March 24, 1890.

Dear Sir,

We herewith hand our opinion of the three samples arrowroot, namely, "Owia," "Fancy," and "Wallilabo." The last-mentioned in point of quality we find to be the strongest, and the others, "Owia" and "Fancy," to be about on a par. The marks "Owia" and "Fancy" have been well known on this market for many years, and have borne a great reputation, but during the last few years there has been a considerable falling off in quality and appearance, so much so that they now have reached the low level of inferior brands. In other words, they have lost their reputation.

We remain, &c.

J. R. Jackson, Esq., (Signed) Fergusson and Forster.
Royal Gardens, Kew.

Analyses of Arrowroot Soils.

Mr. John Hughes, F.C.S., F.I.C., to Royal Gardens, Kew.

Analytical Laboratory, 79, Mark Lane, E.C.
June 27, 1890.

Dear Sir,

I have now the pleasure of sending you the results of my examination of the 10 soils referred to in your letter of the 4th instant.

In general composition these 10 soils appear to be so similar that it will not be necessary for me to refer to them under separate reports. On analysis they are found to be singularly poor in *nitrogen*, *phosphoric acid*, and *potash*. They are, further, of a very siliceous character, and possess small retentive properties, so that, under the influence of a stimulating climate, they would naturally suffer from exhaustion, and require manure if the crops grown were likely to require a generous supply of the above-named constituents of plant food.

The three specimens marked "Owia" are darker in appearance, and though more stony than those from the other two estates, are yet richer in *nitrogen*, soil No. 2 containing the most, and No. 3 the least. In *phosphoric acid* and *potash*, however, there appears, from the complete analyses made, to be little difference, as the figures for these constituents are remarkably close for all three estates. In lime the three soils from "Owia" are all richer,

No. 1 containing 3·175 per cent. of lime,
No. 2 „ 3·056 „ „
No. 3 „ 2·553 „ „

"Fancy" estate comes next,

No. 1	containing	2·296	per cent.	of lime.
No. 2	„	1·385	„	„
No. 3	„	1·953	„	„
No. 4	„	1·665	„	„

"Wallilabo" containing least,

No. 1	containing	1·027	per cent.	of lime.
No. 2	„	2·296	„	„
No. 3	„	1·101	„	„

I do not, however, consider that liming is necessary for any of the soils, and certainly not lime in a free or caustic state, though as finely ground chalk, gypsum, or finely ground bone meal, its application in moderate doses of 3 to 5 cwt. per acre will doubtless be attended with improved crops.

Arrowroot as a crop is not particularly exhaustive of the mineral constituents of the soil, such as phosphoric acid, potash, and lime, and the same remark may be applied to nitrogen, provided that all the pulp and manufacturing residue be returned to the land. Still, with all possible care, there must be a certain amount of exhaustion of the soil going on, which careful cultivation should replace by judicious manuring.

In addition to the application of ordinary farmyard manure, commonly called in the West Indies pen manure (or at least where such cannot be obtained), I would suggest a general manure of the following composition containing per cent. of the following :—

Soluble phosphate of lime (tribasic phosphate rendered soluble by acid) - -	15 per cent
Insoluble phosphate derived from bone flour -	10 „
Nitrogen as derived from sulphate of ammonia	2½ „
Nitrogen as derived from fish, dried blood, bone meal - - - - -	2 „
Potash derived from sulphate of potash -	4 „

Such a manure can be obtained in London for about 8*l.* per ton, and should be applied at the rate of 5 cwt. per acre before the rainy reason sets in.

Believe me, &c.

D. Morris, Esq., F.L.S.,
Royal Gardens, Kew.

(Signed) JOHN HUGHES.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew, August 27, 1890.

I AM desired by Mr. Thiselton-Dyer to inform you that there has been forwarded to Kew, at the request of the Honourable Sir Walter Hely-Hutchinson, K.C.M.G., Governor-in-Chief of the Windward Islands, an extensive series of plants and tubers of the common arrowroot, of manufactured arrowroot, of the soils of the principal estates producing arrowroot, and detailed descriptions respecting the methods pursued at St. Vincent in cultivating and manufacturing arrowroot.

2. These specimens were sent with the view of instituting an inquiry into the circumstances which have led to the low prices paid in this country of late years for the best brands of St. Vincent arrowroot, and in the hope that some useful suggestion might be obtained calculated to revive the name and credit of this article in the London market.

3. As the subject was felt to be of considerable importance, steps have been taken to obtain as much information as possible on this side. The plants and roots have been examined, the soils have been analysed by an agricultural chemist, the manufactured article has been submitted to experts for valuation and report, and the methods of cultivating and manufacturing arrowroot pursued at St. Vincent have been carefully compared with the methods pursued in other countries.

4. The general results of the inquiry will be given in detail later. It is well known that the best arrowroot at present in the market is Bermuda arrowroot. This obtains prices more than double, or even treble those obtained for St. Vincent arrowroot. Bermuda arrowroot may therefore be taken as the standard of what a good arrowroot should be, and the circumstances of its cultivation and manufacture are well deserving of consideration.

5. There is no reason to suppose that the arrowroot plants cultivated at Bermuda and St. Vincent differ in any essential respects from one another. Plants have been obtained direct from Bermuda and cultivated in the Bahamas and other islands in the West Indies, and the arrowroot prepared from them according to West Indian methods has been classed as St. Vincent arrowroot.

6. As regards soil, we appear to have no authentic analysis of Bermuda soils. It may, however, be assumed that they have been formed by the disintegration of coral rock, and that they are tolerably rich in lime, phosphoric acid, and other important constituents of plant life. In a recent account of the arrowroot industry in Bermuda (a copy of which is enclosed marked A.), it is stated that "the ground is first well manured and ploughed deep." The advantage derived from such treatment is obvious. The St. Vincent soils, on the other hand, as may be gathered from the analyses furnished by Mr. John Hughes, F.I.C., F.C.S., are "singularly poor in nitrogen, phosphoric acid, and potash; they are "further of a very silicious character, and possess small retentive "properties." It does not appear that manuring is regularly and systematically pursued on St. Vincent estates, and deep ploughing appears to give place to hole digging with hoes.

7. It is impossible to institute a more detailed comparison between the cultural methods pursued respectively at St. Vincent and Bermuda; but enough has been said to show that the advantages as regards soil and culture so far lie with Bermuda.

8. It is probable, however, that the superiority of Bermuda arrowroot depends as much upon the methods of manufacture as on soil and its treatment. In the account of the industry already cited, stress is laid on the fact that "at Bermuda the roots, after being collected, are "washed, and their outer skin completely removed; this operation has to "be performed with great nicety, as the cuticle contains a resinous "matter which imparts colour and a disagreeable flavour to the starch, "which no subsequent treatment can remove." In the accounts given of the manufacture at St. Vincent, it appears that the skin is not always so carefully removed from the roots before they are pulped. One account, however, states that "in former times the roots were very care-"fully skinned with German silver knives . . . but it was so laborious "and expensive it was discontinued. The method of pulping now "generally adopted is to feed the clean unskinned roots against a fine saw "grater, very similar to a potato grater."

9. In other respects, the process of manufacture pursued at St. Vincent appears to be carried on without that scrupulous care and

attention to details pursued at Bermuda. There may also be some difference in the quality of the water employed. The peculiar blue tint noticed in Bermuda arrowroot is said to be due to the use of water from limestone springs. If water from streams or rivers is used at St. Vincent, although wholesome and pure, it may still be capable of giving a dark colour to the arrowroot.

10. It is evident, however, that the present position of St. Vincent arrowroot is only to a small extent due to the character of the water. At one time, when possibly the same water was used, the quality was much better. It is probable that a gradual exhaustion of the soil and a less skilful and a cheaper method of preparation have been the determining circumstances. In any case it is clear, as shown in the report by Messrs. Fergusson & Forster, that "during the last few years there has "been a considerable falling off in quality and appearance (in St. "Vincent arrowroots), so much so that they now have reached the low "level of inferior brands. In other words, they have lost their "reputation."

11. Messrs. Fergusson and Forster are supported in their opinion by other experts to whom samples of arrowroot have been forwarded from Kew. It would be fruitless to dwell any longer on this point. The fact appears to be established that St. Vincent arrowroots in their present condition will only obtain the lowest prices. It remains, therefore, for the planters in St. Vincent to realise the fact, and to make a systematic effort to bring about a more satisfactory order of things. The matter is evidently in a great measure in their own hands, and if they will energetically grapple with the situation there is every probability that they will untimately re-establish the good name of their produce.

12. The hints given by Mr. Hughes as regards the mineral constituents wanting in the soil should receive careful attention. The treatment of the soil might be improved by a deeper and more thorough cultivation. The methods of manufacture pursued at Bermuda might be carefully studied by an intelligent representative of the St. Vincent planters, and every effort made to carry on the manufacture at St. Vincent on the Bermuda lines.

13. These suggestions, and others which will no doubt present themselves to those reading the reports enclosed with this letter, might be placed within reach of all concerned in the arrowroot industry of St. Vincent. Mr. Thiselton-Dyer will be happy to give any further assistance, and it will afford him pleasure to aid the praiseworthy and sympathetic effort made by Sir Walter Hely-Hutchinson to place this industry on a satisfactory footing. The planters in St. Vincent have had numerous difficulties to contend with of late years, but the improvement of an important industry like this is a subject well worthy of their most earnest and careful attention.

I have, &c.
(Signed) D. Morris.

Edward Wingfield, Esq., C.B.,
Colonial Office, S.W.

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, September 2, 1890.

I am directed by Lord Knutsford to acknowledge, with thanks, the receipt of your letter of the 27th ultimo, containing suggestions for the improvement of the cultivation of arrowroot in St. Vincent, and to

inform you that a copy of your letter, with its enclosures, has been transmitted to the Governor-in-Chief of the Windward Islands.

I am, &c.

The Director, (Signed) Robert G. W. Herbert.
Royal Gardens, Kew.

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, February 2, 1891.

With reference to your letter of the 27th of August last, on the subject of the cultivation of arrowroot, I am directed by Lord Knutsford to inform you that the Governor-in-Chief of the Windward Islands has requested that his best thanks may be conveyed to you for the care and trouble which you have taken in dealing with the subject.

I am, &c.

The Director, (Signed) Edward Wingfield.
Royal Gardens, Kew.

Disease in Arrowroot.

Curator, Botanical Station, St. Vincent, to Royal Gardens, Kew.

Botanical Station, St. Vincent,
Sir, February 12, 1891.

I have the honour to forward for your consideration samples of diseased arrowroot, locally known as "burnt," but which I think more resembles the growth of a fungus. A short time ago considerable attention was paid by the Kew authorities to St. Vincent arrowroot, and I think it most desirable that this matter should also receive attention. A sample of the soil in which it was grown is forwarded, also a copy of the letter which accompanied it.

I have, &c.
(Signed) H. Powell.

W. T. Thiselton-Dyer, Esq., C.M.G.,
Royal Gardens, Kew.

[Enclosure.]

Sir, St. Vincent, January 26, 1891.

I beg to hand herewith a few roots of arrowroot grown on the Spring Estate, "Leeward," which show signs of mildew or decay, just at the time they are fit to be dug. The labourers refer to them as "burnt roots," but I do not think that any of the effects of heat are traceable upon them.

I would be glad if you could find out for me whether there is any disease, either blight or otherwise, which has affected the roots; the leaves are not at all affected. These roots are met with at irregular intervals in the field, and would form a rather large per-centage on a small cultivation.

I am, &c.

Mr. H. Powell, Curator, (Signed) Alfred E. Lewis.
Botanical Station.

Professor Marshall Ward, F.R.S., to Royal Gardens, Kew.

Botanical Laboratory, Forest School,
My dear Thiselton-Dyer, Cooper's Hill, March 20, 1891.

The specimens of arrowroot sent are very badly affected with a subterranean fungus-mycelium, which enters the stem and destroys much of the tissue. The black patches in the latter—seen on cutting the stem—are thickly matted mycelium. By cultivation in damp chamber at rather high temperature, I have made the hypha produce conidia, the "Spicaria" form of older systematists, but there is not sufficient evidence to decide finally as to the species, &c.

It is pretty clear that the fungus can spread from one rhizome to another on or below the surface of the soil. From this, and from the information in letter (returned), I should urge the advisability of digging up and burning all affected plants, and this should be done on the diseased spots, so as to bake the soil there.

I am, &c.
(Signed) H. Marshall Ward.

W. T. Thiselton-Dyer, Esq., F.R.S., C.M.G., C.I.E.,
Royal Gardens, Kew.

Royal Gardens, Kew, to the Administrator, St. Vincent.

Royal Gardens, Kew,
Dear Captain Maling, March 26, 1891.

We lately received through Mr. Powell, Curator of the Botanical Station at St. Vincent, some rhizomes of arrowroot from diseased plants from a Windward estate. The planter who sent them states that the roots "show signs of mildew or decay just at the time "they are fit to be dug; the labourers refer to them as 'burnt "roots.'"

2. As anything affecting your arrowroot industry is of considerable importance to the island, we have had these roots very carefully examined by Professor Marshall Ward, F.R.S., and his report is herewith enclosed. It is evident from this report that the roots are badly attacked by an underground fungus or mildew, and steps should be taken, without delay, to take up all diseased roots and burn them on the spot.

3. When the roots are destroyed in this manner the soil from which they have been taken might be turned over and dressed with lime. The particular spots where the disease has appeared might be left unplanted for a season or two to allow the fungus spores to be eliminated from the soil.

4. These are very simple and practicable suggestions, and those who recognise the presence of the disease on their estates will doubtless take advantage of the information now given to prevent it from spreading to any serious extent.

I am, &c.
His Honour Captain Maling, (Signed) D. Morris.
Administrator, St. Vincent.

PRESENT POSITION OF ST. VINCENT ARROWROOT.

MESSRS. FERGUSSON AND FORSTER to ROYAL GARDENS, KEW.

13, Great Tower Street, London, E.C.,
14th August 1893.

DEAR SIR,

WE have not hastily replied to yours of the 8th instant, because, before doing so, we were anxious to collect and give you the best information respecting St. Vincent arrowroot. The chocolate and cocoa manufacturers, as you may know, are the great consumers of this article, and coming, as they do, into the market for large quantities they naturally raise prices, sometimes considerably, as it is well understood these purchasers are not re-sellers. On the top of this there is oftentimes a speculative movement, and hence prices are unduly raised. We do not think that there is much chance for any great advance to be expected for some time in the qualities used by the manufacturers. The prices they have been paying of late have been $2\frac{3}{4}d.$, $3d.$, to $3\frac{1}{4}d.$ per lb., the importation being greater than for the last year or two. The good estate growths have fetched $3\frac{3}{4}d.$, $4d.$, $4\frac{1}{2}d.$, and $5d.$ to $6d.$ for choice lots.

We may here mention that recently a parcel appeared upon the market from Grenada which fetched $3d.$ per lb. and was thought equal to the best St. Vincent. We also have information that a much larger quantity is expected from Bermuda shortly. This island has always sent us the very finest qualities, ranging from $2s.$ $2d.$ to $1s.$ $3d.$ per lb., only, however, in small quantities. We heard also that we may expect a good supply from Natal, which a few years ago used to send us considerable quantities and realised mostly higher prices than the best quality of St. Vincent. In conclusion we feel certain that the growers in St. Vincent would do well for themselves if they could manage to send to this market more of the finer grades than they have been doing of late years.

We remain, &c.

(Signed) FERGUSSON AND FORSTER.

D. Morris, Esq., C.M.G.,
Royal Gardens, Kew.

CCCXXVIII.—PULPING LIBERIAN COFFEE.

The cultivation of Liberian Coffee is extending in many parts of the world, especially in Java, the Straits Settlements, and the West Coast of Africa. Information respecting this coffee has been given rather fully in the *Kew Bulletin* (1888, p. 261, and 1890, pp. 107 and 245). In the *Kew Bulletin* for 1892, pp. 277–282, there is given a detailed account, with the actual yield, of several estates in the Malay States, showing that Liberian coffee can be successfully established at elevations much below those suited for Arabian coffee, and further, that crops of 9 to 12 cwts. per acre can be obtained from trees after the third or fourth year. In some countries difficulty has been experienced in preparing Liberian coffee for the market. Inquiry has often been addressed to Kew on the subject, and it is desirable to place on record such facts as have been obtained after careful inquiry amongst persons possessing the necessary experience.

It is well known that when the Liberian coffee is ripe the pulp investing the beans is never soft, as in Arabian coffee. It is generally of a tough fibrous character, and offers considerable resistance during the process of pulping. This circumstance has discouraged many people just starting, and, after vainly trying to overcome the difficulty, they have given up the cultivation of Liberian coffee as impracticable. It would appear, however, that if rightly managed there is no special hindrance to be overcome. The first point to be attended to is to pick the cherries when perfectly ripe, and when brought in they should be passed through a simple machine, called a "sizer," in order to obtain two or three lots of cherries of similar size. Cherries of unequal size cannot be successfully treated. That is well understood by everyone who has had experience with Liberian, or indeed any coffee. When the cherries have been sized they are then to be passed through the "pulper." There are special pulping machines prepared for treating Liberian coffee fitted with an adjustable "breast" suited to different sizes of cherries.

There are other and larger machines, combining both a sizer and pulper in one. A machine of this latter kind, made by John Gordon & Co., of London, is described as follows :—

"The machine is provided with a rotary screen and an elevator; it is also fitted with a patent adjustable breast, having removable working parts made of steel.

"The hopper is divided into two unequal parts, and the coffee berries are delivered into the larger division with a constant stream of water, the water being absolutely necessary to float the coffee over into the machine and to carry off the pulp and skins. The coffee berries which, owing to difference in size, pass through the machine unpulped are discharged by the screen into the elevator and delivered by it into the smaller division of the hopper, and thence they pass into a separate channel of the breast, which should be adjusted to the size of the berries thus brought into the machine by the elevator.

"The working of the machine is simple, and the only part which requires care is the breast, and if this be carefully fixed and its channels intelligently regulated, no difficulty whatever will be found in obtaining good results, always provided that the coffee be ripe and freshly picked."

A smaller machine, capable of being worked by hand, is also made by the same firm. The makers attach great importance to certain points considered essential in regard to Liberian coffee. These have already been briefly alluded to. They say that "in order to obtain good results, "it is imperative that the coffee be ripe, freshly picked, and fed into "the machine with *a constant stream of water*."

Further information on the treatment of Liberian coffee is contained in the following correspondence :—

Messrs. John Gordon & Co. to Royal Gardens, Kew.

Dashwood House, 9, New Broad Street, E.C.,
6th May 1893.

Dear Sir,

We thank you for your favour of yesterday, and shall be very pleased to forward copies of our catalogue to the addresses you have kindly favoured us with. We have supplied pulpers for Liberian coffee to Java, West Coast of Africa, and mostly to the Malay Peninsula. One firm there, Messrs. Hill and Rathbone, have had six or seven pulpers; they have also our peelers and separators. You may know

that we sent Mr. Hart, of the Botanical Gardens, Trinidad, one of our small pulpers, with which he obtained very good results.

It is quite imperative that water be used in pulping, and where it is not obtainable the only course, we fear, is to dry the coffee in the cherry, when it can very well be peeled, only this takes some power.

Yours truly,

D. Morris, Esq., (Signed) John Gordon & Co.
Royal Gardens, Kew.

Messrs. John Gordon & Co. to Royal Gardens, Kew.

9, New Broad Street, London, E.C.,
10th May 1893.

Dear Sir,

We are obliged by your favour of yesterday, and we now beg to inform you that our peelers and separators will treat Liberian equally as well as ordinary Arabian coffee, and that as far as these machines are concerned there is no difference in construction. It is only in the operation of pulping where difficulty has been found, necessitating a special pulper.

Yours truly,

D. Morris, Esq., F.L.S., (Signed) John Gordon & Co.
Royal Gardens, Kew.

CCCXXIX.—FIBRE INVESTIGATIONS IN THE UNITED STATES.

The annual report upon the fibre investigations undertaken in the United States under the auspices of the Department of Agriculture by Mr. Charles R. Dodge in 1892 has just been issued.

In this report the further explorations in regard to the distribution of plants of Sisal Hemp in Florida are given, together with the results of some experimental operations undertaken to extract fibre from the leaves by means of the Van Buren cleaning machine. Some interesting particulars are given respecting the distribution and possible utilisation of Bowstring Hemp plants in Florida, and an inquiry has been started with regard to extracting commercial fibre from the leaves of the pine-apple plant. It is stated in the report that the United States import fibre from Yucatan and elsewhere to the value of about five million dollars yearly, and as the Florida article is of better quality, it is claimed that it should command a higher price in the market than that from Mexico.

Further, it is pointed out that New Zealand flax is readily grown on the Pacific coast, and could be produced in many other portions of the country. Last year the United States imported 67,000 bales of New Zealand flax, which, according to the report, could as readily be grown in the United States as imported from the Antipodes.

Sisal Hemp.

Experiments in extracting fibre from leaves of Sisal Hemp in Florida were carried on at Cocoa-nut Grove in Biscayne Bay. Here a cleaning factory was established with a Van Buren machine. "The results of "the season's work were in every way satisfactory, and a considerable

" quantity of valuable material in the form of fibre products were " secured, which will enable the Department to test the fibre in " manufacture, and ascertain the facts regarding yield of fibre per ton " (of leaves), tensile strength, and commercial value."

As regards the supply of leaves for these experiments, it is interesting to note that the larger quantity was obtained from the neighbourhood of the original planting of Sisal Hemp made by Dr. Perrine on Indian Key (see *Kew Bulletin*, March 1887, pp. 4, 5; and 1892, pp. 25, 26) nearly 50 years ago. The chief and more important sort found in Florida is the smooth-leaved plant known as *Agave rigida* var. *sisalana*, similar in every way to the Bahamas plant. There is also a sort armed with teeth, called in the report the "spined form," similar to the plant generally cultivated in Yucatan. This is not nearly so widely distributed as the smooth-leaved sort. There is a third sort of *Agave* found in Florida called the "False Sisal." This was described for the first time by Mr. Baker in the *Kew Bulletin*, 1892, July and August, p. 183. The false Sisal (*Agave decipiens*) has shorter and narrower leaves "nearly always rolled in at the sides, so that a cross section " appears like the letter U. In colour it is a brighter, more livid " green." It is said to yield a fibre "greatly deficient in strength."

Mr. Dodge reports that the people in the Bahamas "carried off by " purchase, or otherwise, schooner loads of false Sisal from Florida," for planting purposes. As the fibre from this sort has been found "very inferior, both in quantity and quality," he advises that it should be carefully avoided by those collecting suckers for starting fresh plantations.

Weight of Sisal Leaves.—In a counting of nearly a ton weight of leaves obtained from Indian Key it was found that they gave an average weight of 1·41 pounds (about one pound six and a half ounces) per leaf. "This " average is lower than would have been the case if the cuttings had " been made invariably from old mature plants." Several smaller lots of specially selected leaves from large isolated plants gave the following weights per leaf, viz.:—2·64 pounds; 2·08 pounds; 1·85 pounds and 2·27 pounds. This shows a range from one pound thirteen and a half ounces to two pounds ten ounces per leaf.

Yield of Fibre.—In Yucatan Mr. Dodge estimates that a ton of leaves yields a little over 82 pounds net of dry fibre. In his experiments with the Van Buren machine he found that a ton of Florida Sisal leaves yielded a little short of 79 pounds of dry fibre. He adds that "the " machine made a very considerable waste, which, after being carefully " washed and dried gave [an extra yield] of 22½ pounds per ton of leaves." There are, therefore, at least about 102 pounds of available fibre in a ton of *Agave* leaves, but in this case it was possible only to extract a little short of 79 pounds. In the Bahamas, according to Mr. T. J. MacLain, the U.S. Consul at Nassau, the average yield of 2,000 pounds weight of Sisal leaves is 75 pounds of dry fibre (equivalent to 83 pounds per ton). These several figures will be found useful in regard to future calculations as to the yield of Sisal Hemp leaves. They may be briefly stated as follows:—A ton of green leaves contains, probably, 102 pounds of dry fibre, but so far in actual working the yield has been in Yucatan (with the Raspador), 82 pounds; in Florida (with Van Buren machine), 79 pounds; in Bahamas (no machine stated), 83 pounds. In other words, the yield of fibre as compared with the weight of leaves is approximately as follows:—Highest possible yield, 4·6 per cent.; yield in Yucatan (with the Raspador), 3·6 per cent.; yield in Florida (with

Van Buren machine), 3·5 per cent.; yield in the Bahamas (machine not stated), 3·7 per cent.

It is impossible from the Florida experiments to obtain the actual yield of dry fibre per day of ten hours, or the cost per ton in cleaning the fibre. We gather that "no attempt was made to estimate the cost "of cleaning—the main object being to secure thoroughly well cleaned "fibre without regard to the time occupied in passing the leaves "through the machine."

The Machine Question.—Nothing of a practical character appears to have been accomplished as yet in the United States in securing a thoroughly satisfactory machine for cleaning Sisal leaves. One new machine called the J. C. Todd machine is noticed, and an illustration given. This is supplied with an automatic feeding arrangement, and is apparently of a somewhat complicated character. No facts are given as to its cost, weight, the power required, or capacity. A report on an American machine known as the Weicher machine, now on trial in this country, was published in the *Kew Bulletin* in June last (1893, p. 141).

Pine-apple Fibre.

The pine apple is cultivated in Florida for the sake of its fruit, which is exported to the northern markets. The number of fruits shipped during 1892 amounted to nearly two millions. "The principal planta-"tions on the Keys are found at Elliotts and Key Largo, though "plantations are found to the southward of these for many miles. On "the mainland there are more or less extensive plantations from the "extreme southern portions of the State northward on the west coast "to Charlotte Harbour, and on the east along the Indian River to the "Lake Worth and Jupiter region." Leaves of pine-apple were treated by "the Van Buren machine, which, while it turned out a superb "product, would be wholly inadequate for the work from a commercial "stand point, as only two or three leaves could be fed in at a time." The leaves experimented upon were obtained from plants of the Red Spanish pine-apple. They were cut the day after the fruit was gathered. Many were injured by chafing and bruising. The actual yield from 1,022 pounds of leaves was 25 pounds of fibre thoroughly dry. This would be at the rate of about 55 pounds to the ton of leaves, or 2·5 per cent. nearly; other experiments gave a yield of a little over 40 pounds and 42 pounds respectively of dry fibre to the ton of leaves. "Estimating 10 "pine-apple leaves to the pound there would be over 22,000 leaves to "the ton, which, as we have seen, would produce from 50 to 60 pounds "of dry fibre."

Bowstring Hemp.

The principal and possibly the only species of Bowstring Hemp cultivated in Florida is *Sansevieria guineensis*. The plant figured by Mr. Dodge opposite page 373 of his report is what is regarded as the broad-leaved variety of this species. It evidently flourishes with great vigour in Florida, for in the experiments at Biscayne Bay it was possible to select over a hundred pounds of leaves that averaged 6½ feet, and yielding fibre 6 feet in length. In general the leaves varied from 2½ feet to to 7 feet. "Careful estimates based on the quantity of *Sansevieria* fibre "produced in one experiment would give the yield at about 40 pounds "of dry fibre to the ton of leaves. It has been explained that the Van "Buren machine made too large a per-centage of waste. . . . but "with only reasonable wastage the yield of fibre per ton should come

" nearer to 50 pounds." This latter yield would be at the rate of 2·25 per cent. The opinion is expressed that although this is much below the yield of Sisal Hemp, "the quick growth of the plant, the ease with " which it can be harvested and handled, and the higher price of the " fibre, will probably more than make up for the difference in yield of " the cleaned fibre." Full particulars respecting Bowstring Hemp, and the various species of plants yielding it, will be found in the *Kew Bulletin*, May 1887, pp. 1–11.

CCCXXX.—DECADES KEWENSES.

PLANTARUM NOVARUM IN HERBARIO HORTI REGII CONSERVATARUM.

DECAS VI.

51. **Euonymus aculeatus**, *Hemsl.* [Celastrineæ]; undique glaberrimus, ramulis crassiusculis cortice flavescenti, foliis longiuscule petiolatis crasse coriaceis flavescentibus lanceolatis vel oblanceolatis acuminatis subacutis basi cuneatis remote minuteque calloso-denticulatis vel infra medium integris costa crassa venis primariis lateralibus utrinque 5–6 petiolo crasso, cymis axillaribus pedunculatis dichotomis ramulis 4-angulatis divaricatis, floribus numerosis tetrameris mediocribus, calycis lobis brevissimis rotundatis, petalis fere orbicularibus brevissime unguiculatis vix undulatis, antheris magnis, filamentis brevissimis supra lobos incrassatos disci insertis, ovario papilloso 4-loculari loculis 2-ovulatis, fructu globoso aculeato, aculeis numerosissimis vix rigidis.

Habitat.—South Patung, Hupeh, and South Wushan, Szechuen, China, *A. Henry*, 5335A and 6143.

Frutex 1–3 pedalis (fide *Henry*). *Folia* 3–6 poll. longa, petiolo ½–1 poll. longo. *Cymæ* circiter 3 poll. longæ. *Flores* 4–5 lineas diametro. *Fructus* immaturus 6 lineas diametro.

Allied to *E. echinatus*, Wall., differing in being of a yellow colour in the dried state, larger thicker leaves on relatively long petioles, almost obsolete calyx-lobes and very short filaments.

52. **Euonymus cornutus**, *Hemsl.* [Celastrineæ]; undique petalis exceptis glaberrimus, ramulis teretibus graciliusculis lateralibus insigniter divaricatis, foliis breviter petiolatis vix coriaceis lineari-lanceolatis longis longe acuteque acuminatis basi cuneatis minute calloso-serrulatis venis primariis distantibus inter se et cum tertiariis anastomosantibus, cymis 2–3-floris axillaribus, pedunculo elongato pedicellisque gracillimis fere capillaribus, floribus rubescentibus mediocribus sæpius tetrameris, calycis lobis fere orbicularibus margine minute erosis, petalis obovatis intus obscure puberulis, antheris magnis subsessilibus, ovario 4–5-loculari, stylo brevissimo, fructu dorso sursum longe 4–5-cornuto caeterum lævi, cornubus cum placentis alternantibus.

Habitat.—Fang and Chienshih, Hupeh, China, *A. Henry*, 5442A, 5954A, 6815A.

Frutex parvus (fide *Henry*). *Folia* 1–6½ poll. longa, sæpius 3–5 poll. longa, maxima 9 lineas lata, petiolo 1½–3 lineas longo. *Pedunculi* 1½–2 poll. longi, pedicellis 6–9 lineas longis. *Flores* 5–6 lineas diametro. *Fructus* apertus circiter 1¼ poll. diametro.

This species is characterised by long narrow leaves, exceedingly slender peduncles and horned fruit, the horns alternating with the placentas.

53. Euonymus myrianthus, *Hemsl.* [Celastrineæ]; undique glaberrimus, ramulis teretibus crassiusculis, foliis breviter petiolatis subcoriaceis lanceolatis oblanceolatis vel interdum obovatis acuminatis et subacutis vel obtusis vel rotundatis basi cuneatis plus minusve crenato-denticulatis, venis primariis utrinque circiter 10, petiolo distincte canaliculato, cymis numerosis confertis breviter pedunculatis multifloris in axillis foliorum superiorum et pseudoterminalibus ramulis divaricatis gracillimis 4-angulatis, floribus tetrameris flavis majusculis, calycis lobis latis rotundatis membranaceis minute paucidenticulatis, petalis ellipticis, antheris magnis subsessilibus, disco lato brevissime cupulari, ovario lævi 4-loculari stigmate subsessili, fructu ovoideo tota longitudine 4-alato.

Habitat.—South Patung and Chienshih, Hupeh, China, *A. Henry*, 5335, 5945.

Frutex vel arbor usque ad 20 ped. altus (fide *Henry*). *Folia* 2–5 poll. longa, sed sæpius 3–4 poll. longa, petiolo 2–3 lineas longo. *Cymæ* circiter 2 poll. longæ et latæ. *Flores* 7–8 lineas diametro. *Fructus* immaturus circiter 9 lineas longus et 5 lineas latus.

This resembles *E. pendulus*, Wall. in the subterminal inflorescence, but the fruit is totally different.

54. Euonymus venosus, *Hemsl.* [Celastrineæ], undique glaberrimus, ramulis verruculosis subquadrangulatis, foliis breviter petiolatis coriaceis pallidis anguste oblongis anguste lanceolatis vel oblanceolatis subacutis vel utrinque obtusis remote minuteque calloso-denticulatis creberrime venosis venis elevatis insigniter anastomosantibus, cymis parvis pauciforis sæpissime supra-axillaribus, floribus minutis brevissime pedicellatis tetrameris, calycis lobis fere orbicularibus integris, petalis cucullato-orbicularibus venosis, filamentis filiformibus quam antheris longioribus, ovario 4-loculari, stylo brevissimo, fructu sæpius abortu uniloculari lævi pisiformi minimo.

Habitat.—North and South Wushan, Szechuen, and South Patung, Hupeh, China, *A. Henry*, 5778, 7019, 7284.

Frutex 5–8 pedalis (fide *Henry*). *Folia* $1\frac{1}{2}$–5 poll. longa sed sæpius 2–4 poll. longa, petiolo circiter 2 lineas longo. *Cymæ* circiter pollicares. *Sepala* minutissima. *Petala* vix sesquilineam diametro. *Fructus* vix 3 lineas diametro.

A very distinct species, remarkable for the close and curiously anastomosing venation of the leaves.

55. Ornithogalum (Cathissa) natalense, *Baker* [Liliaceæ], bulbo ignoto, foliis 2–3 linearibus basalibus suberectis pilosis margine conspicue ciliatis, pedunculo brevi, racemo laxo multifloro, pedicellis brevibus ascendentibus, bracteis e basi lata lanceolatis, perianthio albo magnitudine mediocri segmentis oblongo-lanceolatis exterioribus dorso carina obscura rubro-brunnea trinervata præditis, staminibus perianthio distincte brevioribus, filamentis linearibus conformibus puberulis, antheris parvis oblongis, stylo ovario æquilongo.

Habitat.—Natal, summit of Amanahqua Mountain, alt. 6,800 feet, *J. M. Wood*, 4567.

Folia 3–4 poll. longa. *Pedunculus* 1–4 pollicaris. *Racemus* $1\frac{1}{2}$–3 poll. longus, pedicellis inferioribus 3–4 lin. longis. *Perianthium* 3–4 lin. longum.

Nearly allied to *O. hispidum*, Hornem. (*Anthericum pilosum*, Jacq. Ic. t. 416.)

56. Asparagus (Asparagopsis) Buchananı, *Baker* [Liliaceæ-Asparageæ]; fruticosus, late sarmentosus, ramis gracilibus glabris, spinis duris pungentibus subrectis, cladodiis 2–6-nis angustissime linearibus ascendentibus elongatis, racemis copiosis segregatis laxifloris, bracteis minutis ovato-lanceolatis, pedicellis erecto-patentibus flore longioribus apice articulatis, floribus hermaphroditis, perianthio campanulato albo segmentis oblanceolatis obtusis flore expanso patulis, staminibus perianthio æquilongis, filamentis filiformibus, antheris parvis globosis, ovario ovoideo, stylo brevi, stigmate brevissime tricuspidato.

Habitat.—Shiré highlands, *Buchanan*, 757, 1503.

Spinæ inferiores 3–4 lin. longæ. *Cladodia* 8–9 lin. longa. *Racemi* 1½–2 pollicares. *Perianthium* 1 lin. longum.

Nearly allied to *A. racemosus*, Willd.

57. Polypodium (Phymatodes) dulitense, *Baker* [Filices]; rhizomate gracili late repente, paleis lanceolatis membranaceis ascendentibus pallide brunneis, stipitibus rigidis elongatis nudis stramineis, frondibus parvis ovatis simplicibus acutis vel acuminatis chartaceis glabris nitidulis siccitate pallide brunneis dimidio inferiori crenatis basi rotundatis vel deltoideis, venis primariis erecto-patentibus parallelis remotis, venulis in areolas hexagonas venulis liberis inclusis anastomosantibus, soris parvis globosis subimmersis.

Habitat.—Mount Dulit, Sarawak, Borneo. Collected by Mr. Chas. Hose. Sent to Kew by the Bishop of Sarawak and Singapore in July 1893 as No. 301.

Stipites 3–5 poll. longi. *Lamina* 2–3 poll. longa, supra basin 9–21 lin. lata.

A pretty little dwarf species, nearly allied to *P. Labrusca*, Hook.

58. Polypodium (Goniopteris) firmulum, *Baker* [Filices]; rhizomate lignoso cylindrico nudo late repente, stipitibus nudis elongatis, frondibus oblongo-lanceolatis simpliciter pinnatis firmulis glabris, rachi pubescente, pinnis paucijugis sessilibus lanceolatis acuminatis subintegris basi truncatis vel late cuneatis, venis primariis erecto-patentibus ad marginem parallelis, areolis inter costam et marginem 4–5-seriatis, soris parvis laxe dispositis superficialibus inter venas primarias biseriatis.

Habitat.—Mount Dulit, Sarawak, Borneo. Collected by Mr. Chas. Hose. Sent to Kew in July 1893 by the Bishop of Sarawak and Singapore as No. 295.

Stipites sesquipedales. *Lamina* pedalis vel sesquipedalis; *pinnæ* 3–4 poll. longæ, 9–12 lin. latæ. *Venæ* primariæ 1½–2 lin. inter se distantes.

Allied to *P. urophyllum*, Wall., and the North Australian *P. pœcilophlebium*, Hook. There are traces of a rudimentary indusium.

59. Polypodium (Grammatis) Maxwellii, *Baker* [Filices]; rhizomate breviter repente, paleis densis erectis lanceolatis membranaceis pallide brunneis, stipitibus brevissimis nudis contiguis, frondibus simplicibus linearibus integris obtusis firmulis ad basin attenuatis utrinque nudis glabris venis remotis erecto-patentibus furcatis ad marginem haud attingentibus, soris uniseriatis globosis subimmersis laxe dispositis ad costam approximatis.

Habitat.—Mount Guding, Sarawak, Borneo. Collected by the Bishop of Sarawak and Singapore and sent by him to Kew in July 1893, as No. 296.

Lamina 1–2½ poll. longa, medio 1½ lin. lata.

Habit of *P. subevenosum*, Baker, from which it differs by its produced forked veins. Named, at the request of Bishop Hose, after the Hon. F. R. O. Maxwell, H.M. Resident at Sarawak, who accompanied him on the expedition when it was found.

60. **Vittaria (Euvittaria) crassifolia**, *Baker* [Filices] ; rhizomate breviter repente lignoso, frondibus contiguis sessilibus linearibus percrassis fragilibus glabris nitidulis siccitate pallide brunneis ad basin sensim attenuatis, venulis immersis occultis, soris in frondis marginem immersis ad laminæ partem superiorem solum productis.

Habitat.—Mount Dulit, Sarawak, Borneo, alt. 5,200 feet. Collected by Mr. Chas. Hose. Received from Dr. Hose, Bishop of Sarawak and Singapore, July 1893, as No. 306.

Lamina, 4–5 poll. longa, medio 2 lin. lata.

Combines the thick texture and entirely hidden veins, except the midrib, of *V. sulcata* and *falcata*, with the strictly marginal sori of *V. elongata*. Though so thick the fronds break across very easily. The sori are deeply immersed in the upper part of the frond, and its altered margins enclose them, that of the upper surface projecting a very little beyond that of the lower surface.

CCCXXXI.—HENEQUEN HEMP IN YUCATAN.

The following interesting report on the Henequen hemp industry in Yucatan was published last year by the Foreign Office [F.O., Misc. Series, No. 236, 1892.] It was prepared by Mr. A. Pierce, the Vice-Consul at Merida, and it furnishes data respecting the cultivation and extraction of Henequen (or Sisal) hemp, likely to prove generally useful. The report is reproduced in the *Kew Bulletin*, for the purpose of placing it within convenient reach of many persons in India and the Colonies interested in the subject:—

Question 1.—What is the total present production of henequen in Yucatan, and its probable increase ?

It is generally calculated that for the present year, 1892, from January to December, the export of Yucatan hemp will be nearly 350,000 bales, and taking the said bales at about 375 lbs. Spanish each will give a total of 131,250,000 lbs., and this amount comes from 1,312,500 mecates, a Spanish measure of ground of 24 varas square, each mecate giving 100 lbs. yearly, as a general calculation on the basis of 82 plants each mecate. By this means of calculation it is shown that the production of fibre comes from 270 square miles Mexican of land under cultivation, as each mecate of 24 varas square equals 576 square varas ;* the said 270 square miles being about 30¼ square leagues. The above data are taken from the best possible source, but cannot be considered as entirely reliable, as there are no means here of proving such calculations ; there being probably a third part more land under cultivation of henequen, the product of which will come forward in the course of the next three years, so that it can be considered (although not proved) that there are some 350 square miles of land under hemp

* 1 vara = 2·782 feet.—Ed.

cultivation, or, in the opinion of many, the full area that such cultivation will require ; the port of export being Progreso.

A hemp plantation lasts for some 15 years, as a general calculation on the basis of production, for each mecate, of 100 lbs. From time of planting out of suckers until they produce five years, as a rule, are required. On good land the crop commences in four years or earlier, whilst on rocky ground from six years or more. These calculations are based on the planting out of suckers under the same conditions in both kinds of ground, with plants of from 18 inches to 20 inches long. Hemp planted on fertile land produces less weight of fibre, although it is longer and finer, because on rocky soil the roots run along the surface, instead of penetrating into the ground.

As generally recognised there are seven classes of this agave, of which only two are cultivated, which are easily distinguished and bear their native names, first, "Sacqui," or white hemp, from the fact that the leaves in sunlight appear silvery, the leaves being light green, and second, "Yaxqui," or dark green leaves. The first named is the kind almost entirely cultivated here, there being a very small proportion of the second, and this principally in the eastern part of the State. The remaining classes known are not used, having very small leaves and little fibre.

Although new plants are being continually placed with the old ones, it is considered that no more than the 350 square miles will be cultivated, as old plants are always dying out. The only chance of a larger area coming under cultivation is from immigration, and this is extremely difficult, owing to the great heat of the climate. It is not considered that the utmost production at one time in this State will exceed 400,000 bales to 450,000 bales, of from 350 lbs to 375 lbs., As there are many bales of the first-named weight the proportion of increase will be more or less as follows :—

	Bales.	
1891	310,000	
1892	340,000	*
1893	360,000	*
1894	380,000	*
1895	400,000	*

The above calculations are based on the new plantations that will begin to produce year by year.

It must be borne in mind that the plant here has long, strong leaves with thorns on both edges, and a sharp point at the end of the leaf.

The plants can be produced from seeds, but this system is never used here, being extremely lengthy, suckers being always used.

Question 2.—What is the minimum cost of production, including cost of labour, buildings, machinery, &c. ?

The great increase of expenses in production during the hemp fever of 1888–89, when this fibre reached the fabulous price of 14 c.‡ to 15 c. per lb. (it being calculated that the cost of production, packed and delivered, in the port of Progreso is about 3½ c. to 4 c. per lb.), have been but partially reduced since, so that at the present time it can be

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* The utmost.

† The value of the Mexican dollar fluctuates considerably, but the average value for the year ending March 31, 1892, may be taken at 6 dol. 54 c. to the £.—Ed.

calculated that the fibre costs, put in bales and delivered in the port of Progreso, about 4 c. per lb., Mexican money. This is a general calculation, as much depends on the greater or less distance of farms from our port, and the more or less favourable means of transit, and also from the advantages possessed on farms by reason of the number of servants, extent of plantations, &c.

Question 3.—What is the nature of cultivation, character of soil, and general treatment?

The nature of the cultivation of this plant is very simple. As has been mentioned, the plantations are formed by suckers of from 18 inches to 20 inches of leaf in length planted in straight lines leaving lanes between, usually from east to west, more from custom than any known reason or cause, and, as mentioned, the number of plants in each mecate of 24 varas (Spanish) square is 84, placing each sucker 2 varas from another, or rows of 12 by 7 plants equals 84 plants. Formerly it was the custom to plant only 64 plants in each mecate, but the great increase in this business gave rise to an increase in the number per mecate. The planting of 84 to a mecate is considered the most convenient, both for the working and the growth of the plants.

As before mentioned, rocky ground is the most favourable for this plant, and the only preparation made for sowing the hemp is to clear the ground of trees and plants, the former serving to make charcoal. The first crop sown on the ground so cleaned is maize, this being the quickest crop; this gives time for farmers to rail in their land until hemp is ready to take the place of corn. Here the divisions of farms consist of stone walls, there being always a great supply of stone on the land. Then the plantations are laid out, as mentioned, in straight lines, and with the usual number of plants per mecate, according to the extent of land disposable, and in the most convenient manner for taking the leaves when cut to the cleaning machine. On the majority of farms portable railways have been laid, these being of 50 centimetre gauge, rails 10 lbs. to the foot; the larger part of this material being from the French market, the Decauville system. The Belgians have also sent large quantities of this portable material, rails and sleepers combined costing about 1 dol. 12½ c. per metre.

On most farms the ground is cleared of weeds twice a year, and on others three times, according to the class of ground, means of the farmer, &c. The quick growth of weeds, especially in the rainy season, impedes the due growth of the hemp plants.

There is no fixed rule as to the right time for cutting the leaves, and on this point no certain reason can be given; opinions differ as to the proper time, and the Indian servants only seem to know, when the leaves are ripe for cutting.

As to cutting, the usual custom is to take from each plant, commencing from below, some few leaves in the first year of production, and afterwards some 24 leaves from each plant. If from want of labour the farmer is obliged to cut more leaves from each plant at one time, he tries not to cut more than 12. Too much cutting kills the plant very soon. On the other hand, plants cannot be left without cutting the leaves when ripe, as by cutting the plant continues producing; for it has been observed that plants cut plentifully will last from 15 years to 18 years in continual production.

As soon as the plant produces a long rod from the core, the plant should be destroyed as it no longer gives leaves. The rod flowers and

gives seeds, but as mentioned before the latter are not used in planta tions.

In order to go on replacing plantations without special expense, and in order not to change the form or work on same, it is the custom to place at the foot of each plant when about three-fourths of its life are spent a small plant, which latter when the old one gives out is ready for production.

There are several opinions as to the best means of planting the suckers. Although in general the suckers are taken from the old plantations and at once placed in new plantations, trials have been made, and with satisfactory results apparently, of leaving the suckers before placing them in fresh plantations in heaps in the open for some two months more or less, placed so as to receive the full heat of the sun on the base of the plant (in form like an onion), from which the roots are taken off. On being taken to new plantations the base is peeled and any dry roots removed, and all dry leaves thrown away. Although the suckers are apparently ruined by this exposure, and for the first two years present a very poor appearance, looking completely dried up, yet in the third year they regain such strength in growing that they then are superior to plants placed out fresh—that is, planted out direct from the old plantation to the new one ; and this advantage is seen by their producing more leaves, and those stronger and larger than the other plants. When farms have no old plantations from which to gather the necessary suckers of 18 inches to 20 inches, they are produced by providing space for small plants or seedlings; these are placed in the ground as if they were vegetables, with from 4 inches to 5 inches of leaf, and planted in rows about 3 inches or 4 inches apart, and some 10 inches or 12 inches between each row, the distance being regulated by the size of the plants. On planting out seedlings the roots are taken off. As referred to in making new plantations, it is also convenient to leave these seedlings exposed for some 8 days to 15 days before planting them. They have to be watered now and again, but only sufficiently to keep the ground from becoming too dry. On attaining a sufficient size the plants are passed to new plantations as mentioned above.

Question 4.—What is the machinery used, power required, and quantity of fibre produced per machine per day ?

The machinery most generally in use here for extracting the fibre is the rasping wheel, manufactured by Death and Ellwood, of Leicester, England, as also all the other necessary parts completing the apparatus; but for some time since the farmers only buy the principal piece, the wheel which is 40 inches in diameter, 8-inch face, and 1½ inches thick. The great increase in the cultivation of this plant has caused farmers to look for quicker means of extracting the fibre, as many have over-sown, and are unable to attend properly to what they have sown, and the scarcity of labour tends to increase this need; but although much study has been given to the matter, only amongst the larger farmers, who can stand the expense, can new machines be employed such as will compensate for the want of labour. The wheel above mentioned with two men for direct management can clean some 9,000 leaves per day, each wheel requiring about 1½ horse-power English.

For some little time since in some of the very largest farms, the machines known as Prieto, Villamor, and Thebaud have been in use, these three all trying to obtain the first place in the estimation of the farmers.

DATA relating to the Machinery in use in Yucatan for extracting Henequen Fibre, taking as a basis Farms of not less than 1,000 mecates of Hemp under Cultivation.

——	——	Wheels Old Style.	Prieto.	Villamor.	Stephens or Thebaud.
Cost of machine on the farm -	Dollars -	225	6,000	4,000	10,000
Cost of setting up - - -	„ -	25	2,000	1,000	2,500
Horse-power, English, required	Horse-power	1½	16	18	20
Labourers for direct service of machinery.	Number -	3	5	4	5
Leaves cleared, per day of 10 hours.	„ -	9,000	100,000	50,000	100,000
Product of cleaned hemp, good quality.	Per cent. -	90	85	90	80
Product of mixed fibre, or badly cleaned.	„ -	—	10	5	15
Loss of fibre and bark, &c. -	„ -	10	5	5	5

The clean fibre of the machine of Stephens or Thebaud obtains in the United States from ½ c. to 1 c. more per pound than the fibre obtained up to present time from the other machines.

The mixed or badly cleaned fibre is worth from 25 per cent. to 50 per cent. less in value according to class; this class from the Stephens' machine is worth less than like class from the Prieto. Red hemp comes from the well cleaned grade, being stained or dirty, and is sold in this market from 1½ c. to 2 c. per pound less than good cleaned. Red hemp, badly cleaned, is of very little value, and is generally consumed here in rope making or other native industries.

Other machines for fibre cleaning are spoken of, some recently patented, such as Maden, Albee Smith, and R. A. Keene, all of American make. Up to the present the first two named have been tried here, but have not given satisfactory results. It is said that the improvements made in them have been of little account, hence it is not considered that in present form they can compete with the machines mentioned in the present notes.

DATA relating to ordinary Expenses on all Farms, independently of Style of Machinery in use.

Leaf cutter, one man, 200 leaves per day, is paid 25 c. per day.

For carting leaves from plantation to cleaning machinery, done either by tramway or on mule back, it being rare to find farms who do same by carts, as experience has shown that by mules it is more economical, and still more so by tramway, especially on farms of great size.

Four men paid each 50 c. per day of 10 hours can move 120,000 leaves by tramway. One mule can draw one waggon with 3,000 leaves, and make five trips, according to distance, in 10 hours. The mule requires in corn and green food 20 c. daily.

For 10,000 leaves by mules are required 1 driver, whose pay is 37½ c. daily; 5 mules, costing each 20 c. daily.

Each mule carries 200 leaves each trip, so that for a task of 10,000 leaves 10 trips are made.

The men who attend the drying of fibre after extraction, and collect it dry and carry it to press for packing, are paid as follows :—

If the service is done by tramway, one man is required for each 20,000 leaves, and his daily wage is 50 c., and the work is done on small cars drawn by hand.

If the service is performed by hand small boys and men unable to do harder work are employed, calculating one for each 10,000 leaves, they being paid 25 c. daily ; this system being much longer in question of time. The man who clears away refuse gains 37½ c. daily.

The engine driver gains from 20 dol. to 40 dol. per month. On large farms a stoker is also employed at 50 c. daily. 1 kilom. of portable railway, of 50 centims. wide and 5 kilos. to the metre, costs, laid down, about 1,400 dol. One platform car for carrying 3,000 leaves costs about 150 dol.

The pressing of hemp fibre into bales is done on the farms by means of lever or screw presses, by hand or by hydraulic pressure. The latter are now becoming general.

The bales vary from 350 lbs. to 400 lbs., some farms going to 450 lbs. but as a medium weight on the entire production a weight of 360 lbs. is used.

The cubic measurement of ordinary bales is about 22 feet ; with hydraulic presses, on same basis of 350 lbs. or 400 lbs., about 20 feet per bale.

On most farms the pressing is done apart from other work, and paid for, from 10 c. to 15 c. per bale, according to class of press used. One man can make from 4 bales to 5 bales daily, so that his wage is from 50 c. to 75 c. daily.

The screw presses are American manufacture, and cost from 250 dol. to 500 dol. each. The hydraulic presses are English manufacture, and cost from 3,000 dol. to 6,000 dol., according to size and capacity.

The bands put on bales are made on the farms by farm hands, who are paid from 25 c. to 50 c. daily. Each bale requires from 100 feet to 120 feet of rope, weighing from 3½ lbs. to 5 lbs., for each bale. According to size and weight of each bale from 4 bands to 6 bands are put on each. The cost of bands is about 5 c. each. The bales are sold, including the weight of bands, these being usually made of the inferior grades of fibre.

The marks of bales cost the farmer about 1 c. each, being made from gunny bags.

The cost of administration of farms is calculated from 50 dol. to 100 dol. monthly, according to size. The head servant gains from 30 dol. to 60 dol. monthly, but certain concessions are made him which bring up the amount to the first named sum.

The owner of a farm only treats with the head servant, who renders him all accounts, and this servant attends to all the work, receiving his orders from the owner.

Fuel for engine is wood, obtained from the farm itself. The way of obtaining same is varied, but the general custom is by piecework, of about 75 lbs. to 125 lbs., when wood is dry or wet. This amount is paid for from 37½ c. to 50 c.

Coal is not used on farms, due to the very heavy expenses it incurs from landing in Progreso to a farm, such expenses being some 10 dol. per ton over cost of same in port.

A part of general expenses of a farm are the cleaners or weeders of plantations, and these are paid at the rate of 25 c. per mecate. This cleaning has to be done at least once a year.

Expenses on hemp from farm to port of shipment (Progreso)—a general calculation is 20 c. per 100 lbs.

An export duty (State) is payable on hemp entering Progreso of 15 c. per 100 lbs.

Once in Progreso, charges are :—

Warehouse charges, including receiving, storage for three months, and delivery on pier for shipment, 6 c. per 100 lbs.

Weighing, per agreement, from 2 c. to 3 c. per bale.

Wharf dues, 75 c. per 2,000 lbs.

Lighterage, in native canoes, of from 40 bale to 150 bale capacity, to vessels at anchor, independent of distance, at 30 c. per bale of 350 lbs. to 500 lbs. and 40 c. per bale above 500 lbs.

The customs entries cost about 2 dol. 75 c. per shipment, independently of number of bales shipped.

The foregoing details give all principal particulars relating to machinery employed and the results obtained, as also expenses.

The product of fibre, as above mentioned, is that from 1,000 leaves 50 lbs. of fibre are extracted as a general rule, and according to class, but there are leaves which give up to 100 lbs. per 1,000, this, however, being the exception. From fifth to seventh year of yield of a good plant 75 lbs. per 1,000 leaves can be considered an average yield.

Question 5.—Description of any other appliances used in the cultivation, manufacture, or packing.

The above data and general notes complete the information required under this number.

Question 6.—Principal markets and cost of freight thereto.

The principal markets for Sisal hemp are as follows :—

The United States, principally through New York and Boston. New Orleans is also taking considerable fibre, and there is a probability of Philadelphia being a direct importer.

England, through Liverpool principally.

France, through Havre.

Germany, through Hamburg.

Cuba, by Havana.

Spain, by Seville, Alicante, and Barcelona.

CCCXXXII.—CALIFORNIAN FRUIT INDUSTRIES.

The remarkable development of the fruit industry in California is a matter of considerable interest to those engaged in a similar industry in other parts of the world. In a recent Report issued by the Foreign Office (Annual Series 1893, No. 1251) on the trade and agriculture of San Francisco, by Consul Donohoe, there is given the following account of the present position and prospects of Californian fruit industries :—

San Francisco.

Green fruit sent to England.—During the last season the experiment was tried of sending green fruit direct to London. The time occupied in transit from Sacramento by the first shipment was a little over 14

days, and the fruit is said to have arrived in good condition, having been kept in refrigerators the whole time. It was all sold in a few days, but the prices did not rule so high as had been hoped, and the outcome was unsatisfactory.

Oranges.—The crop of 1891–2 was considerably smaller than that of 1890–91, owing to a destructive wind-storm, which did much damage in Los Angeles and Orange counties, and heavy frosts. Prices ranged low, owing to the generally inferior quality of the fruit. A grave error was made in shipping fruit, damaged by frost especially, to the Eastern markets, which lowered the esteem in which Californian oranges have been held. The overland shipments from six southern counties are estimated at about 3,000 car-loads, against 4,000 for 1891. Oranges are grown in 38 out of the 54 counties of the state.

Prunes.—Early in the spring of 1892 the indications were favourable for a very large crop (expected to reach 40,000,000 lbs.), but, like many other kinds of fruit, the prune was severely injured by the late rains and cold weather, and it is not probable that the season's crop will exceed 20,000,000 lbs. Prices were good except for a short time, when they declined, but soon advanced again, and remained stationary. The acreage planted in 1892 was less than in 1891, owing probably to a growing impression of danger of over-doing the business.

Raisins.—The present season's crop turned out better than was expected, and prices were higher than last year, which was principally brought about by a combination among the growers. There is considerable fear expressed that the business may be overdone, and the new acreage set to raisins was comparatively small.

The imports of foreign raisins into the United States for the years ending June 30, 1891 and 1892, are given as follows :—

Year.	Quantity.	Value.
	Lbs.	£
1891	39,572,655	403,776
1892	20,687,640	192,862

Apples.—Apple-growing is quite extensive in some of the northern counties of the State, and is a more important industry in California than is generally believed.

Figs.—Great interest is being taken in fig-growing and packing especially in the southern part of the State, where large areas of new land have been set to this fruit in the past few years. While the fig as yet does not hold a place of commercial importance in our State, it promises in a few years to take a prominent position among our fruit exports.

Olives.—The olive is another fruit to which great attention has lately been paid. The cultivation of the olive and the manufacture of its oil became of such importance that it was deemed advisable to organise the growers into an association for the advancement and protection of this industry, and an organisation was effected in 1891. The industry is greatly hampered by the adulteration of the oil.

Grapes.—The frosts did a good deal of damage to the grape crop, which accounts for the small vintage for the year. The vineyardists have been discouraged by the low prices for grapes, and the phylloxera has made rapid advances in some parts of the State.

Opinions are divided as to the value of the so-called beneficial insects which have been imported from Australia to prey on those that injure fruit trees.

Tacoma.

Horticultural information.—The State Board of Horticulture have published a very interesting and instructive report relative to the cultivation, care, and treatment of the various fruits, seeds, and plants in this State, which ought to be in the hands of every person who takes an interest in fruit-growing, hops, and gardening. Complete descriptions are given of the pests, insects, and fungi of various kinds which have made their appearance in many of the orchards, hop yards, and gardens of the State, and the remedies most beneficial for their eradication. It contains, besides, papers on the method of growing hops, plant food and fertilisers, irrigation, seed tables, ages for fruit-bearing trees and yields, grafting, waxes, &c.

Spraying is now in common practice, not only in the hop yards, but in the orchards also, and experience has taught all that it is the only way to ensure a crop. There are about 30,000 acres in this State planted with fruit trees, besides small fruits and gardens; half of these trees have been planted only four years, and have not arrived at bearing age, but in the next five years, it is believed, the annual bearing fruit crop will be about 600,000*l.* ($3,000,000), and the hop industry of equal value and importance. It is recommended to divide the State into horticultural districts, with a commissioner for each, who should be a pest inspector for his district, and be responsible for the condition of his district; and also that lectures at various centres should be given on entomology, &c., for the benefit of the farmer and gardener.

Some of the best orchards in the country have been almost entirely destroyed by insects, which spoil the fruit and kill the tree in a short time.

The most destructive pests are the San José scale, the woolly and green aphis, codlin-moth, hop-aphis, the box-elder bug, and caterpillars.

All the land east of the Cascade Mountains, where water by irrigation can be had, if judiciously used, will grow good fruit, and a good portion can be planted in orchards without irrigation; the light, ashy, and sandy soil is especially adapted to fruit cultivation, also to hops and vegetables. It is easily cultivated and very productive. The moisture in many places is kept up by constant cultivation. West of the Cascade Mountains, in the Puget Sound country, the uplands will prove the best fruit lands, especially for apples. The clay loams are good, but not the marshes. No country can surpass this west side for cherries and small fruits, such as gooseberries, currants, raspberries, and strawberries; the latter is the most profitable.

Pruning is done generally just after winter, before the sap starts, and in June.

The market is best generally during the early summer, the late autumn, and winter.

Los Angeles and Wilmington.

Fruits are the leading products of Southern California, and heretofore have been almost altogether consumed in the United States, being shipped as a rule overland. There is apparently a surplus for export, which in the near future must be largely increased; but the question

whether these fruits or any of them can be profitably disposed of in the English markets, cannot, on account of the great distance and the cost of transportation, be said to be definitely settled. Canned fruits are shipped to England from San Francisco in large quantities, but this portion of the State scarcely enjoys, so far, equal facilities for that trade, and we have only one considerable canning establishment, viz., the Southern California Packing Company of this city, the manager of which, Mr. Welsh, believes that for the present at least he can sell his product to best advantage in the home markets of the United States.

Oranges.—Oranges are our leading fruit. This season's crop, now (March 1893) in process of being marketed, is estimated to amount to 6,000 car-loads, each of 300 70 lb. boxes (about 60,000 tons); and the domestic sale is so far rather slow, on account of the competition of Florida, Mexican, and Sicilian fruit, and of excessive cold weather lessening the consumption in the Eastern States. Within a few years it is believed the crop will amount to 20,000 car-loads, about 200,000 tons, and there is no present visible domestic market for such a quantity. I recently conversed here with Mr. Lawrence Connolly, a gentleman of 40 years' experience in this business, and head of the firm of L. Connolly and Company of Liverpool, the largest handlers of oranges in England, concerning the possibility of marketing there a portion of this crop. He said that the Californian navel orange was, in his opinion, well adapted for sustaining a long travel and delay in reaching market, far superior in this respect to Florida oranges, which are tender in comparison. He only knew one orange equal to the navel that reached the English market, that is the Jaffa orange, the crop of which is exhausted by February 1, and, therefore, not in competition with the navel, and so far as he was aware there was no additional source of supply of such fruit nearer than California. Heretofore the crop has been a limited one, and readily absorbed by domestic markets; the ideas of growers as to the value of this fruit are rather exalted. Some navels are now procurable as low as 6*s.* per box, but the best are held at from 8*s.* to 10*s.* per box at primary points, and Mr. Connolly could not be sure that a higher price than 14*s.* per box could be realised in Liverpool, at least until the fruit had been introduced and become appreciated; while the cost of transport, which must be usually in refrigerated chambers and by fast freight train to New York, would, of course, be very heavy. A trial car, shipped by the Earl Fruit Company of this city to Mr. Connolly's firm in Liverpool, sold on March 17, 1893, for 14*s.* per box. The expense of shipment is estimated at 10*s.* per box, leaving only 4*s.* per box for the grower. Besides this house, which is very extensive and enterprising, there are various other good firms with which English dealers might correspond, such as the German Fruit Company, the California Fruit Company, Griffin and Skelly of Riverside, and Cook and Langley are very extensively engaged in the domestic trade, but have little faith in the success of dealings with England. They think that country too far away and to possess more convenient sources of supply than California. Besides the navels it is hoped that some sale may also be found in England for our seedlings and Valencia lates, between June and September.

Lemons.—This trade is in process of development here, but as yet even San Francisco imports largely from Sicily.

Deciduous fruits.—Apricots and peaches are produced to a considerable extent, and Southern California appears specially favourable

to the apricot. Both are shipped fresh and dried as well as canned, and Mr. Connolly believed the fresh fruit might sell successfully in England, while he was of opinion that our pears and plums could not displace the French and English.

Prunes are a speciality of Northern California, and in a few years that part of the state will yield an enormous surplus of them.

Raisins.—Fresno, in Central California, is the chief seat of this production, though a considerable proportion is also raised in Southern California. The Fresno fruit is a few weeks earlier than ours. Cook and Langley and Griffin and Skelly are the chief packers and shippers. The industry is in rather a bad way, production being even now excessive, and with the prospect of an enormous increase in the immediate future from vines coming into bearing. Unfortunately, this great production has been undertaken on the encouragement of real estate owners, without any definite markets in view beyond the domestic, and it is therefore hard to say what is to become of it all. The raisins are of medium quality, not equal to Malaga fruit, though of the same description, layers and loose muscatels. Much of last season's crop has only netted the growers from ½*d.* to 1*d.* per lb., which, of course, is a dead loss. A portion of the prospective crop may be sold green to the Eastern States, and distillation and syrup manufacture are also suggested as affording some outlet; some may find its way to England and her dependencies, but, beyond doubt, a considerable proportion will never be gathered, and the vines to a large extent will be rooted up by-and-bye to make way for other crops. This refers to proximate production, for all of last year's, reaching 42,000,000 lbs. will find a sale, though at low rates. Sultana or seedless raisins are not in excessive supply, and fetch good prices.

Walnuts. — Southern California is already a large producer of walnuts; about 100 car-loads have been shipped east during the past season. The crop is usually handled by the German Fruit Company of this city, and sells easily, on the average, at about 3½*d.* to 4*d.* per lb. Within five years from now the crop may be so much increased from new plantations as to afford a surplus for export, but at present even the American cities of the Atlantic coast are chiefly supplied from European sources, and the amount of land perfectly suited for this production in Southern California appears to be limited.

Mr. Ernest Watson, an Englishman who has a large orange grove at Duarte, in this county, writes me in reply to some queries I propounded to him to the following effect, that the best districts for orange growing is the eastern portion of Los Angeles county; that the best orange land, with an adequate supply of water, cannot be purchased for less than 100*l.* per acre; that "the Mexican oranges are likely to menace "the Christmas market, but hardly at all after the end of January, as "they come in during September, and our market does not open until, "practically, the middle of February, and continuing until the middle of "June," and that the best oranges to plant are those ripening between April and June (such as "Valencia lates" and "Mediterranean sweets"), when most of the Mexican, Florida, and Mediterranean oranges are out of the market.

CCCXXXIII.—PLANT INDUSTRIES IN THE CAUCASUS.

The following interesting particulars respecting the wine, liquorice and mulberry industries carried on in the Caucasus are taken from the Report of the Statistician of the United States Department of Agriculture for June 1893:—

The Wine Industry.

Of highest importance for the present and the future of the country is wine growing. The production does not only suffice for home consumption, but supplies to a large extent the wants of Russia, and besides, furnishes a considerable quantity for export. The efforts of Russia for the advancement of this branch of rural industry are praiseworthy. Under Ottoman rule viticulture could not flourish, as its object was confined to the production of table grapes, and thus it remained on a level with the culture of other fruits. A changed political situation, introduction of new customs, and the effectual assistance of the Russian Government have shown the rural population a rich source of income in wine growing.

Prince Michael Waronzow, the governor of Caucasia, procured in the year 1848, 120,000 vines from his own vineyards in the Crimea and from the most celebrated vineyards of Europe, in order to distribute them among the inhabitants of sections adapted to viticulture.

Not all of them did well; the varieties have been crossed; but a beginning had been made, an impulse given, and this profitable branch of rural industry has developed gradually to its present flourishing condition. There are still a few drawbacks; otherwise the results of this industry would have been enormous. There is, above all, the phylloxera, which has made considerable progress during the last few years. The war upon this plague is waged only on the large estates of rich landholders, while the majority of small vineyards is open to the disease. The damage is largest in the governments of Tiflis and Elizabethpol. In Erivan the winter frosts damage the vines materially.

Area of vineyards.—The vineyards of the Caucasus cover an area of 86,000 desatines (232,174 acres), and their annual production is estimated at 13,000,000 vedros (42,237,000 gallons). The average price of Caucasian wine is generally about 25 cents per gallon and goes up to 30 cents only in years of crop failure.

Profits of viticulture.—Notwithstanding the fact that a desatine of land adapted to viticulture costs 1,000 roubles ($182 per acre), this industry proves to be highly profitable, as the net profit averages from 380 to 400 roubles per desatine ($70 to $75 per acre).

Liquorice.

The inhabitants of Elizabethpol and Baku derive considerable benefit from liquorice (*Glycyrrhiza glabra*), which grows wild, needs no cultivation, and multiplies spontaneously. In 1878 two Greeks turned their attention to the large quantities of liquorice in Caucasia; in 1886 they erected a large factory for drying and pressing the liquorice, which they annually export to America. The remunerative trade soon attracted others, and to-day there exist four prominent commercial houses

which carry on a wholesale trade in liquorice, and two of which have erected extract factories in this country.

Annually there are produced about 108,339,000 pounds of raw liquorice, which, after drying, yields 36,113,000 pounds of marketable merchandise. For raw liquorice the factories pay on the average 11 cents per 100 pounds.*

Production of Spirits from Mulberries.

The production of spirits from mulberries, pears, cherries, and other fruits depends upon the yearly result of the vintage, as the producers seek to repair the eventual loss in wine and wine-spirits by substituting the above-named fruits. The production during the last five years averaged about 65,000 vedros (211,185,000 gallons) of mulberry spirits free from water. The other fruits are used for this purpose only in inconsiderable quantities.

CCCXXXIV.—MISCELLANEOUS NOTES.

Borneo.—The Right Rev. the Bishop of Singapore and Sarawak (Dr. Hose) has forwarded to Kew a parcel containing 46 dried specimens of ferns, collected by him at Mount Dulet, Sarawak. Six species have proved to be new; descriptions of these by Mr. J. G. Baker, F.R.S., will appear in the Decades Kewenses, given at intervals in the pages of the *Kew Bulletin*.

Asia Minor.—A continuation, numbering about 200 species, of the collection made by Sintenis in Kastamuni (the ancient Paphlagonia) has been purchased for the Herbarium through Dr. K. Keck, of Aistersheim.

India.—From Mr. J. F. Duthie, F.L.S., Director of the Botanical Department, Northern India, comes a collection of upwards of 1,200 specimens of dried plants collected by him in Kashmir.

Mexico.—Herr H. Kiærskou, Inspector of the Botanical Museum, Copenhagen, has presented to Kew 139 specimens of Mexican plants. They are valuable as containing types of the new species of grasses collected by Liebmann, and described by Dr. Eug. Fournier, in his *Mexicanarum Plantarum Enumeratio*.

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* In a Foreign Office Report (No. 1200 of 1893), on the trade of Aleppo, it is stated: "Liquorice root has largely developed, and merits special attention. Collection is now made on a large scale throughout the province, thus compensating in some degree the peasantry for the losses caused by bad harvests. 6,145 tons, valued at 43,231*l.* were exported to the United States, as compared with 4,293 tons, valued at 28,077*l.*, in 1891."

In a further Foreign Office Report (No. 1261 of 1893), on the trade of Damascus, it is stated: "The only business which Damascus may be said to have lost is the liquorice trade, which has practically died out, owing to the discovery of a better quality of root in Northern Syria, in Asia Minor, and elsewhere."

Greenland and Iceland.—To Herr H. Kiærskou Kew is indebted for 129 specimens of dried plants from Greenland and Iceland, gathered by various collectors.

Leitneria floridana, Chapm.—Dr. W. Trelease, Director of the Missouri Botanic Gardens, St. Louis, U.S.A., has forwarded to Kew a specimen of this species, found by him in Missouri. This interesting plant, previously recorded from the salt marshes of Florida only, was placed by its author in the order Myricaceæ, but raised to the rank of a monotypic order by Bentham and Hooker in the *Genera Plantarum* Vol. III., p. 396. A good figure of it is given in Hooker's *Icones Plantarum*, t. 1044. It forms a shrub from 2 to 6 feet high, somewhat resembling a willow, from which it differs in having a solitary ovule affixed laterally. From *Myrica* it is easily distinguished by the absence of resinous glands in the leaves, while the elongated (not globose) inflorescence separates it from *Platanus*.

Wood of Araucaria.—The trunk of the historic *Araucaria imbricata*, referred to in the *Kew Bulletin* for January last, p. 24, as having died during the previous autumn, has been cut up and a specimen deposited in the Museum. The trunk measures about 30 feet high and 1 foot 4 inches in diameter at the base. A sample of the wood of a tree of this species grown at Tortworth Court, Gloucestershire, and a walking stick made of the same wood, both presented by Earl of Ducie, F.R.S., in 1890, are shown in Museum No. 1. The wood is light, soft, and open-grained, and apparently of but little value economically, though in its native country it is said to be strong and durable. The best known timber-producing species of *Araucaria*, however, are the Moreton Bay Pine (*A. Cunninghamii*, Ait.) and the Bunya Bunya (*A. Bidwilli*, Hook.). The first is a native of Northern New South Wales and Queensland, and the second grows only in Queensland. Both are trees of some 100 to 150 feet high, producing planks of very large size and light-coloured even-grained woods suitable for furniture, flooring, and other carpentry work; some samples of the Moreton Bay Pine are prettily marked with small pale clouded knots, somewhat resembling birds-eye maple. It takes a good polish. Good specimens of both these woods are shown in Museum No. 3.

Photographs of Tropical Scenery.—The collection of photographs in the island of Grenada taken by R. V. Sherring, Esq., F.L.S., deposited in Museum No. 3 in June 1892, and noticed in the *Kew Bulletin* for July and August 1892, p. 187, as a loan collection, has recently been acquired for the Museum, and will now form part of the permanent exhibits. This series is of more than ordinary interest and value, both for the excellence of the photographs themselves and for the accuracy of the scenes they represent. A very good idea of the general conformation of the island can be obtained from them as well as of the indigenous and cultivated vegetation. Two of the most striking of the group are, perhaps, those of Lake Antoine looking across the Atlantic and the Grand Etang with virgin forest. Amongst those representing in-

dividual plants are the Cacao (*Theobroma Cacao*), a fine group of Nutmeg trees (*Myristica fragrans*), and a tree on the Chantilly stream covered with a luxuriant growth of *Asplenium auriculatum*, and *Acrostichum aureum*.

Oak of Mamre, or Abraham's Oak.—A block of the celebrated oak tree, known as Abraham's Oak, from near Hebron has recently been presented to the Kew Museum by Mrs. E. A. Finn. The history of this interesting specimen is as follows:—Mr. Finn, husband of the lady just referred to, occupied the position of British Consul at Jerusalem and Palestine from 1845 to 1863. The branch, of which the specimen now at Kew is part, was broken off in a snow storm, the piece was purchased by Mr. Finn, who had it cut up and brought to Jerusalem in seven camel loads. The greater part of the branch was made up into small articles and sold for the benefit of poor Jews in Palestine. Dr. (now Sir Joseph) Hooker, in a paper, "On Three Oaks of Palestine," read before the Linnean Society of London on 20th June 1861 (*Transactions Linn. Soc.*, Vol. XXIII., p. 381), refers to this tree as the prickly evergreen oak thus:—"*Quercus pseudo-coccifera* is by far the most abundant "tree throughout Syria, covering the rocky hills of Palestine especially "with a dense brushwood of trees 8–12 feet high, branching from the "base, thickly covered with small evergreen rigid leaves, and bearing "acorns copiously. On Mount Carmel it forms nine-tenths of the "shrubby vegetation, and it is almost equally abundant on the west "flanks of the Antilebanon and many slopes and valleys of Lebanon. "Even in localities where it is not now seen, its roots are found in the "soil and dug up for fuel, as in the valleys to the south of Bethlehem. "Owing to the indiscriminate destruction of the forests in Syria, this "oak rarely attains its full size. We saw but few very good trees; one "of which is the famous oak of Mamre, called 'Abraham's Oak,' and "I saw other good ones at Anturah on the Lebanon. Leaves and "acorns of both these were carefully compared with those of the stunted "form that grew around them and elsewhere, and presented no difference "whatever. The 'Abraham's Oak' is popularly supposed to indicate "the spot where grew the oak or lentisk (for it is disputed which) "under which the patriarch pitched his tent, and is reverenced accord-"ingly by Jews, Mahommedans, and Christians. In general habit it "much resembles the *Q. Ilex* as grown in this country, but does not "branch so much from the base, the bark is similar in colour and "fissuring, the branches in direction, and the foliage in colour . . . . "In the winter of 1856-57 in the streets of Jerusalem (elev. "2,200 ft.), the snow fell deep and lay for many days. The accumulation "upon Abraham's Oak was so great that one of the finest boughs "gave way under the weight and fell to the ground. Mr. Schembri, "the highly intelligent dragoman of Jerusalem, informed me that he "was employed by Mr. Finn, British Consul, to bring the bough to that "city for him. Owing to a superstition that any person who should cut "or maim the oak would lose his firstborn son, considerable difficulty "was experienced in procuring hands to saw up the timber for trans-"portation. These were at last brought up from Jerusalem, nearly 25 "miles off, and loaded seven camels with the wood of the one limb of "this fine tree."

Fiji Fruit Trade.—In a report just issued by the Colonial Office on the Fiji Island (No. 72, 1893), the following information is given respecting the fruit trade :—The trade of the Colony has advanced rapidly during the year. The green-fruit trade, however, has not increased to any great extent, and the profits made from the production and export of this staple have undoubtedly fallen off. This is owing, locally, to the presence of a disease among bananas which prevents their bearing. (*Kew Bulletin*, 1890, p. 272; 1892, p. 48.) The Government have for some time been endeavouring to arrange for the temporary services of a pathologist to examine the causes of this disease, and, if possible, to provide a remedy. The trade has also been affected by the competition of the Colony of Queensland in the markets of New South Wales and Victoria. The export of green fruit to New Zealand has, however, doubled within the last four years, as has also that to Victoria. There will always be a sale for Fijian green fruit, as the quality of the bananas produced in Fiji is admittedly superior to that of those coming from Queensland, which are often sold under the name of Fijian bananas. A few of the "Gros Michel" bananas suckers have been imported from Trinidad, with the view of seeing whether they resist the disease better than the locally grown "China" bananas.

Selected Papers from the Kew Bulletin.—The six published volumes of the *Kew Bulletin* (1887–92) contain articles which more or less cover the whole field of commercial enterprise as applied to the vegetable kingdom. These articles are necessarily printed in a disconnected form, in accordance with the principle laid down by the Government that information of public interest should be published as speedily as possible. It will, therefore, be convenient to bring together occasionally the whole of the published papers relating to one particular subject. The trouble of following these through a series of annual volumes would otherwise in great measure defeat the object in view. A volume now in course of preparation, to be followed from time to time by similar collections, deals with the subject of VEGETABLE FIBRES. This is of first-rate importance to manufacturers at home, and also to our planting Colonies. Amongst other subjects, there will appear for the first time a complete account to date of the very interesting Sisal Hemp industry in Yucatan and the Bahamas.

Sisal in Turks Islands.—The cultivation of the Pita (Sisal) plant continues to make progress, and the report of the Assistant Commissioner at Cockburn Harbour on the subject is encouraging. A large extent of fresh ground has been planted out during the year, and several new buildings have been erected in connexion with the industry. Both companies, it is expected, will be in a position to make small shipments of fibre during 1893. A plantation of Sea Island cotton has also been started on one of the adjacent Cays. (*Colonial Office Report*, No. 74, 1893.)

Vine Diseases.—In a letter dated the 24th July last, addressed to Kew by the Secretary of State for Foreign Affairs, there was enclosed a report by Professor Ráthay, of Vienna, on two diseases of vines known respectively as *the Californian Vine disease* and the *Brunnissure*. Mr. Massee has been good enough to furnish the following brief particulars respecting

these diseases:—Professor Emerich Ráthay has given a résumé (Die Weinlaube, 1893) of what is known concerning two forms of vine disease, called respectively "Brunissure" and "California vine disease." The former, first observed in the vineyards of Central France in 1882, has spread rapidly, and is now reported from such distant points as Bessarabia and the United States. The disease is caused by a myxomycete—*Plasmodiophora vitis*, Vial. and Sauv.—closely allied to *Plasmodiophora brassicae*, Wor., the cause of the disease in turnips and cabbages known as "fingers and toes" or "anbury." In the vine the disease is mostly confined to the leaves, and does not, as in the Californian disease, extend to the stem and root; neither is there any distortion of tissues such as results from the attacks of *Plasmodiophora* in other plants. The parasite first develops in the palisade cells of the leaf, and from thence extends to the cells of the spongy parenchyma, occurring only very rarely in the epidermal cells. The first external evidence of the parasite is the presence of small, irregular brown patches on the leaf, these soon increase in size, run into each other, and cover more or less the entire surface except the vines. The wilted appearance of the young shoots, and arrest of development and ripening of the fruit, is the indirect result of the alteration of the leaves by the *Plasmodiophora*. This disease has certainly gained a foothold in England, an example having quite recently been sent to Kew from Sussex for determination. No remedy has yet been discovered, and it has been observed on vines that have been sprayed with sulphate of copper solution for fungoid diseases, its position as an internal parasite protecting it from the effects of any external application. The most exhaustive account of this disease is by Viala and Sauvageau (*Journ. Botanique*, vol. vi., p. 355, 1 pl.; Lechevalier, Paris). The California vine disease, first observed in Los Angeles county in 1882, is devastating numerous Californian vineyards, and has formed the subject of two elaborate reports, issued by the United States Department of Agriculture, 1892. This disease is also caused by a myxomycete, *Plasmodiophora californica*, Viala and Sauv., and the effect is as disastrous as that produced by the dreaded Phylloxera; the parasite attacking with equal energy old and young plants, and in all situations, wild vines, as *V. californica*, not being exempt. The parasite develops within the living cells of the host-plant, the tips of the shoots being first attacked, the disease passing along the branches into the main stem, and finally into the root, thus killing the plant within a short time. The leaves, when first attacked, show patches of a yellowish tinge, soon passing into red, and finally to blackish red, hence the term "black measles," applied by Californian planters at this stage. This disease is unknown in Europe.

Anthracnose in Vines.—The vine disease known by the name of Anthracnose, caused by a minute fungus called *Sphaceloma ampelinum*, De Bary, is well known on the Continent and in North America. As a serious disease, its presence has only been noted in England during the past year, and it is probably widely diffused, specimens have been received at Kew for determination from such distant localities as Dorking and Edinburgh. Anthracnose is an insidious disease, which in its milder forms would not be likely to arouse apprehension on the part of the cultivator, yet successive attacks for four or five years often kill the plant. The young shoots, leaves, flowers, and fruit are attacked. The disease on the young shoots appears at first under the

form of minute brown spots, these soon increase in size and become sunk or depressed at the centre, the epidermis becomes broken up into minute white downy particles, and as the disease extends the shoots become almost black, the internodes are short, and the development of the leaves arrested, not expanding, of a harsh, brittle texture, and hairy below. The present disease is quite distinct from the one known as "black-rot," although the two have by some authorities been considered to be identical. The following method of treatment has generally proved effectual in eradicating the disease. In the spring, before the buds open, the plants should be thoroughly sponged with a 50 per cent. solution of sulphate of iron in water; the atmosphere at this time should be kept damp. When the young shoots are about six inches long they should be dusted with flowers of sulphur, and if the disease makes headway, the dusting should be repeated, the sulphur being mixed with an equal quantity of powdered lime. Very badly diseased plants should be removed and burnt, as such are not amenable to the above or any other mode of treatment. A detailed account of this disease, also preventive methods and treatment, is given by Viala. [*Les maladies de la Vigne.* Masson: Paris.]

Extract of Chestnut Bark.—In a Foreign Office Report [No. 1270, Annual Series, 1893] the following particulars are given respecting this new tanning material prepared in the neighbourhood of St. Malo, France:—"This export is developing, hitherto chiefly sent to Belgium, "though a Glasgow house has taken some of late. It is used in the "process of tanning leather, being made of the bark of chestnut trees. "The export has reached 150 tons to 200 tons per month, and it is "expected that the new manufactory of this essence now about to be "opened at Dinan will double the export hence. The only manufactory "in this district at present is at Montreuil-sur-Ille in this department." This information supplements that conveyed in a F. O. Report [No. 578, Annual Series, 1889] on the trade of Corsica, where it is stated that "Chestnut extracts (from Ajaccio) for tanning purposes have been in "demand for England, and considerable quantities have been shipped." It is said that these Chestnut extracts are used for tanning purposes to modify the colour produced by Hemlock extract (obtained from the hemlock spruce (*Tsuga canadensis*).

Rose-growing and pressing in Saxony.—The experimental rose plantations started two years ago in the neighbourhood of Leipzig have given such brilliant results that they are, the Belgian Consul states, being extended. The plants have thriven well through the long and severe winter of 1892-93, and their condition in May left nothing to be desired. It has been shown that it was a false idea to suppose that these flowers require Oriental heat to prosper and acquire a delicate perfume; the experiments at Leipzig having proved that a cool temperature, and even a little damp, is the first condition of a good yield, whilst great heat is the enemy of roses. A special factory has been established in the middle of the plantations by the house which made the first experiments, and it is to be put in operation this summer. Provision is made for dealing each day—we quote the Consul—"with 50,000 kilogs. of leaves, "producing, at least, about 40 kilogs. of oil, water, and pomade of

" roses, valued at 40,000 to 50,000 marks. To start with, the factory " will have three boilers providing 300 square metres of heated surface, " and the roses will, immediately they are plucked, be transferred to the " macerating jars, where, thanks to this procedure, they will deposit their " perfume in all its freshness and delicacy. Only the quantity of leaves " required at the moment will be collected, a few minutes sufficing to " transfer the leaves from the plant to the machines." *Commerce* of the 26th July adds :—This expedition is favourably contrasted with the procedure followed in Turkey and in France, where frequently the roses plucked in the morning are only distilled in the evening. As to the oil of roses produced in Saxony during last year, it is claimed that not only did it not fall short on comparison with the Turkish product, but that it was better than its rival in delicacy and strength, and the lasting character of its perfume.

Pepper in Siam.—After rice and teak, pepper is the principal export from Siam. In 1892, 1,175 tons were exported, a slight falling off compared with the previous year. The pepper business is entirely in the hands of two British firms here, and as bargains are enclosed simultaneously at London and Bangkok by telegraph, it is a perfectly safe trade. The price, during the year, continued to fall, ranging from 22 ticals per picul (30*l.* 10*s.* per ton) for white pepper, and 16 ticals to 10 ticals (22*l.* 3*s.* to 13*s.* 7*s.* per ton) for black. As recently as 1888 the price reached the high figure of 88*l.* per ton. It would appear that the big profits in those years were made by the middlemen—Chinamen who buy the standing crops, and take all risks of disease and worm. All the pepper sold in the Bangkok market comes from Chantaboon, a district on the east coast of the Gulf of Siam about 180 miles from Bangkok. The two firms above referred to do business through the shipping agent—a German, who runs a small steamer once a week to Chantaboon. The pepper crop is gathered in March, and is in the Bangkok market about a month later. When the berries are plucked, they are put through a winnowing machine with three compartments. The heaviest berries drop into the first, and after being macerated in water, by which the outer black covering is removed, become white pepper. The lighter and inferior berries of the second compartment form black pepper, and those in the third are waste, from which the best grains are extracted and added to the second kind. Of the export, two-thirds were white and one-third black pepper. All the white is shipped to London, and the black to China. The local consumption is small. The freight charged from Chantaboon to Bangkok is about 13*s.* 9*d.* per ton, and there is an inland duty of 1 tical per picul, equivalent to 1*l.* 7*s.* 6*d.* per ton. The prospects for 1893 are good. The quantity seems excellent, and there are no complaints of scarcity, though growers assert if the price falls any lower it will be impossible to continue cultivation (*Foreign Office Consular Report*, No. 1267, 1893).